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PAPERS AND PROCEEDINGS OF THE ANNUAL MEETING

OF THE AMERICAN MOSQUITO CONTROL ASSOCIATION HELD JOINTLY WITH THE ANNUAL MEETING OF THE ILLINOIS MOSQUITO CONTROL ASSOCIATION, CHICAGO, MARCH 6–8, 1951 [1]

THE WORLD CAMPAIGN AGAINST MALARIA

LOUIS L. WILLIAMS, JR.,[2] AND KNUD STOWMAN [3]

From the outset, the World Health Organization was aware of its immense responsibilities and opportunities in regard to malaria control throughout the world. Every member of the Executive Board and every delegate to the World Health Assembly knew that malaria was responsible for more illness and poverty throughout the world than any other disease. They knew that this disease is by far the most important contributory cause of the backward economic state of so many tropical and semi-tropical countries. If southern Asia, Africa and South America could be rid of this disease, international collaboration in health would be justified forever afterward. Malaria control was therefore given top priority at the first World Health Assembly and eradication of this disease set as an ultimate goal.

Excellent work had been done by the League of Nations Malaria Committee, and the new expert committee of the World Health Organization follows in its steps. Three reports now have been published which give valuable advice regarding the central points in malaria control. The World Health Organization is still young and its malaria work has just come to a state of rapid evolution. Only three years ago the permanent organization was set up in Geneva and it took awhile to get teams into the field. At present the WHO is conducting malaria control demonstrations in India, Pakistan, Thailand, Afghanistan and Iran. It has also protected the Arab-Palestine refugee settlements against malaria which would otherwise have caused havoc among the 800,000 inmates of these camps. In each of these demonstrations, the teams are being trained in residual spraying of houses and other anti-malaria work. It is expected that after two years' demonstration the host country will be able to take over and expand the work farther.

The WHO has also furnished malaria consultants to many countries, granted fellowships and given advice to educational institutions. It has sponsored the important African Malaria Conference held in 1950 at Kampala in Uganda, which may prove to have been one of the landmarks on the road toward the economic development of that continent. A closer collaboration in the field of malaria control has been established between the WHO, FAO and UNICEF. It is realized that irrigation works and other agricultural plans in tropical countries are doomed to failure unless accompanied step by step by malaria control. WHO has

[1] This is the first paper to be published under the new publication policy for printing the *Papers and Proceedings*. See note on editorial page.

[2] Medical Director, U. S. Public Health Service; Chief, Health Branch, Division of International Labor, Social and Health Affairs, U. S. Department of State.

[3] Chief, Information and Research, Office of International Health Relations, U. S. Public Health Service, Federal Security Agency.

now a mosquito experimental station near Chiengmai in northern Thailand, in an area where FAO is active.

One should never lose sight of the fact that nearly all malarious countries are poor. Larval control was, therefore, too expensive to be employed other than in small areas of potential wealth or else in marginal lands of malaria's vast domain where a little money was available. With the discovery, toward the end of the recent war, of malaria control by residual spraying of all houses with DDT and other new potent insecticides, this situation was changed over night. Malaria could now be reduced to the vanishing point almost anywhere at a cost of from 20 to 50 U. S. cents per capita a year. This is less than the afflicted countries actually spent on the quinine and other curative remedies.

The amazing and encouraging effect was that the impetus given by WHO to malaria control by residual spraying was so powerful that the programs rapidly outstripped the resources of WHO. In 1949 alone not less than 49 million persons living in endemic areas were protected against malaria by residual spraying programs. Out of this total, only 1,562,600 persons were protected directly by campaigns undertaken by international organizations, which shows that although the World Health Organization has furnished leadership in the great action against malaria, many countries have not waited for outside help before going ahead. Ceylon, Cyprus, Madagascar, Mauritius, the Union of South Africa, British Guiana, Venezuela, Brazil, Argentina and the United States are examples of countries which have already carried out eminently successful programs without other stimulus than the knowledge of the opportunity. This is perhaps the most encouraging aspect of the new all-out offensive against malaria—an aspect of which little has been said or written.

Let us pass briefly in review some of the successful but less well known programs.

South Africa

Malaria is found in the Transvaal over an area of 58,000 sq. miles with 1,350,000 inhabitants between latitudes 22° and 26° South. Endemic areas cover 20,000 sq. miles of which one-half, situated between 500 and 2,500 ft. altitude are heavily endemic. Epidemic malaria is found up to 4,500 ft. The carriers are *Anopheles gambiae* and *A. funestus.*

During the five years up to 1944 the malaria situation had become so bad that farmers were beginning to sell out and leave. As much as 70 per cent of the labor force was down with malaria during the most critical harvest period, and crops were lost. Growing out of a meeting of 17 farmers at the village of Nutfield a demand was made by the Organized Farmers' Union that the Government take immediate action. An appropriation of £33,000 was made for this purpose, but the farmers did not await the official assistance. They put up money, got the help of a local health inspector, and divided themselves into groups of six farms with one farmer responsible for engaging the necessary personnel to oil all the waters on their farms. DDT was introduced in 1945–46 with excellent results. House sprayings are made twice, and in places three times a year. Spraying with 5 per cent DDT in kerosene is used in European houses and 50 per cent DDT wettable powder diluted to 5 per cent in native dwellings; 27.1/2 per cent DDT emulsion diluted to 1 in 300 is applied fortnightly in summer to all breeding places of *A. gambiae* and monthly in winter to all the proven winter-breeding places.

About 42,000 sq. miles have now been cleared of malaria. Parasite rates dropped from 62 per cent to 12 per cent in the age group under 2 years. Post office receipts doubled and the commercial bank turnover nearly quadrupled in a typical previously malarious area. School absenteeism almost disappeared.

Says the Chairman of the Tuinplaats

Anti-malaria Control Committee:

"Developments were coming to a standstill and farmers were finding it difficult to work their existing lands to full capacity through labor shortage. The seasons when rain was plentiful and harvests good, malaria was at its peak and consequently heavy losses occurred. After only five years the prices of these same farms rose from £5 or £6 to £22 per morgen. I consider that the rapid rise is due to the fact that no malaria exists. Farmers have extended their fields considerably and production has jumped up by over 400 per cent and is still on the increase.

"One has only to attend one of the many local functions to see the number of young and very healthy looking children to convince oneself that from being an unhealthy malaria area, we can claim to be one of the healthiest communities in the Union."

Incidentally, in Southern Rhodesia the personnel carrying out malaria control by residual house spraying from October to April devote their time to schistosomiasis control during the dry period from May to September. River banks are then sprayed with copper sulphate to kill the snail carrier while the water is low. The first house spraying is with DDT, the second, three months later, with BHC.

Mauritius

For years and years malaria has been the plague of Mauritius. Except for a small area in the center of the island, too high for malaria, the average spleen rates ranged from 56 to 71 and the parasite rates from 32 to 50 per cent. Plans were made in 1948 for a complete house spraying program modeled on the British Guiana campaign.

The campaign began in January 1949 after a thorough survey had been made. By June the same year *Anopheles funestus,* the principal vector, was reported eradicated except in two small strips along the coast. In addition, *Aedes aegypti* had been virtually eliminated. *Anopheles gambiae* were still present in large numbers, but somehow this dangerous mosquito is of less importance in Mauritius.

The result was that the general death rate, which had ranged from 25 to 30 fell to 16.6 per 1,000 population in 1949. The average spleen rate of children fell to 15.3 per cent and the parasite rate to 2.4 per cent after the first spraying.

Madagascar

A large-scale residual house spraying campaign was started in September 1949. About one million persons have already been reached—one-fourth of them even with two sprayings. An emulsion concentrate containing 5 per cent DDT, 5 per cent BHC and 10 per cent Octachlor was used as well as 50 per cent water wettable DDT. Treatment of swampy areas by helicopter is being considered.

Ceylon

In Asia, Ceylon took the lead in malaria control. A field trial of residual DDT spraying was made in 1945, and the whole malarial part of the island was included in the campaign by the end of 1946.

Malaria was most prevalent in the "dry" part of the island (rainfall 25–75 inches) which should be the most valuable for agriculture, and spleen rates ranged up to 77 per cent. According to Mr. Bandaranaike, the Minister of Health, nearly two-thirds of the land was practically uncultivated owing to malaria. In 1940, 3,413,600 malaria cases were reported, which gives 574 cases per 1,000 inhabitants. One epidemic alone caused 80,000 deaths in 1934–35.

There is only one vector of importance—*Anopheles culicifacies,* which simplifies the problem somewhat. DDT in kerosene solution was used at the outset, but was soon replaced by wettable powder as more suitable for the local dwellings. The campaign is notable for frequency of the applications. The operations are repeated every six, eight or ten weeks. In 1949, the population thus protected numbered 4,500,000, and the cost per head was 22

U. S. cents a year. The whole cost of the three-years' campaign 1947–49 has been $1,840,000.

Up to and including 1946 the general death rate was from 20 to 22 per 1,000 in good years and over 30 in epidemic years. It fell to 14.3 in 1947, 13.2 in 1948 and 12.6 in 1949, which is a record for a tropical country. It should be mentioned that Ceylon has an unusually competent and complete health administration, but it was evidently mainly the malaria campaign which brought about this result. The spleen rate for the whole island was reduced to 2.7 by March 1949. The disease is not eradicated, but true malaria was confirmed by microscopical examination in only 7 per cent of the clinically diagnosed cases. Large tracts of land are now available for intensive cultivation, and increased agricultural production should not only correct the unfavorable trade balance but also alleviate the population pressure for some time to come.

India

In India, where malaria is probably the greatest single cause of poverty, and certainly of sickness and mortality, modern malaria control by residual spraying has so far been undertaken only in a part of Bombay State and at Delhi.

In the Kanara District of western Bombay *Anopheles fluviatilis* is the sole vector. A vector with a very high sporozoite rate, this mosquito has also a very high anthropophilic index. Dwellings alone are therefore sprayed. In the Dharwar District of eastern Bombay *A. culicifacies* is also a vector. This mosquito being zoophilic, cattle sheds are also sprayed. An emulsion of DDT with Aromex and soap is used. As only the DDT has to be procured abroad the cost of spraying is kept down to 13 U. S. cents a year. The campaign began in July 1946.

The results obtained should certainly encourage India to embark on large-scale projects. From 70 per cent before the application of DDT the spleen rate in the Kanara District fell to 7 per cent in March 1949 while the parasite rate was reduced from 20 per cent to 2 per cent. In the Dharwar District, where pre-DDT rates are not available, the spleen rate fell to 8 per cent and the parasite rate to 1 per cent. The operation resulted also in the elimination of human plague, as DDT is effective against the rat-flea carrier.

It is intended gradually to extend the campaign to the whole malarious area of the State which would result in the prevention of 5 million cases now causing a yearly loss of some 960 million rupees. The cost of the campaign would not exceed 15 million rupees a year.

Pakistan

In East Bengal a World Health Organization demonstration team covered 193 sq. miles of a moderately malarious region by house spraying in 1950. A 15 per cent larger yield of the rice crop was reported in the DDT sprayed areas than in non-sprayed control areas in the same district. This increase of yield must be attributed to the greater efficiency with which malaria-free workers have been able to till their fields. The man hours of labor required to perform the field tasks were lowered 10 per cent by the spraying, and no working hours were lost on account of malaria.

Iran

Following a survey by Justin Andrews of the U.S.P.H.S. spraying operations have begun in selected areas of Iran. About 800,000 persons were protected in 1950.

Greece

Malaria in Greece was tackled by UNRRA in 1946. Operations were subsequently carried on by the Greek government assisted by Economic Cooperation Administration and the Public Health Service. Residual spraying of dwellings and cattle sheds is supplemented by aerial spraying of extensive breeding places and some ground larval control where indicated. The principal carriers are *Anopheles sacharovi* and *A. superpictus*. Five of the

seven million people of Greece lived in highly malarious areas. The disease is now practically eliminated, and the parasite rate for infants is zero. At the same time, the widespread papataci fever, carried by sandflies, disappeared, for DDT is as effective against sandflies as it is against mosquitoes and fleas.

It is worth noting that the cost of operations in Greece equals approximately the savings in importation of anti-malarial drugs. The immense savings to the Greek economy effected by disease prevention is therefore really free of cost.

Other Mediterranean Areas

Species eradication, though costly, is particularly tempting in islands. The classical campaigns in Cyprus and Sardinia, which have cleared these two highly malarious islands from the disease, are so well known that I shall not attempt to go into details.

In Cyprus residual spraying of houses has been combined with thorough larval control. *Anopheles superpictus* was the principal vector. A pilot project was carried out in 1946 on the Karpas Peninsula. During the next two years first one-half and next the other half of the island was treated. In January 1950 the Cyprus Government officially announced that malaria had been wholly banished from the island. The total cost of the eradication campaign was £220,000, toward which the United Kingdom made a grant under the Colonial Development and Welfare Act. The population of the island is about 500,000.

In Sardinia the transmitter was *Anopheles labranchiae.* The eradication campaign, begun experimentally in November 1946, was by 1949 based on alternating house spraying and larviciding. It was found necessary to extend the spraying to mine vaults, churches and natural grottos in order to destroy wintering female *labranchiae.* The staff, led by only a dozen technicians under Rockefeller direction, reached at one time the size of 33,000. The total cost has been about 12 million dollars provided by UNRRA lire and dollar funds supplemented by ECA and Rockefeller grants. "The impact of these innovations on the population has been dramatic," says the Rockefeller Foundation Annual Report for 1949. "In time they will no doubt alter the balance of the whole island economy, for new possibilities in the development of Sardinia have been opened up. The island, formerly an economic liability, is emerging as Italy's new frontier. Sardinia is now a healthy place to live and work."

Italy is actively pursuing a campaign of residual spraying of dwellings and cattle sheds which has replaced the costly larviciding programs on the continent. In 1949, there was not a single death from malaria in Italy. The general death rate has reached a low never previously encountered in a Mediterranean country.

British Guiana

As Ceylon in the Eastern Hemisphere, so British Guiana furnishes the most striking example in the Western Hemisphere of successful malaria control by residual spraying. After experimental work in 1945 and 1946 the campaign went into full swing in 1947. "DDT has been used exclusively as a residual spray applied to the interior of houses; hydrological conditions have been ignored and remain to this day what they have always been in the past," according to the summary of Dr. George Giglioli's official report "Malaria, Filariasis and Yellow Fever in British Guiana" published in 1948 by the Mosquito Control Service of the Medical Department of British Guiana.

The malaria vector, *Anopheles darlingi,* as well as *Aedes aegypti* have been eradicated from the treated areas. *Culex quinquefasciatus,* transmitter of *Wuchereria bancrofti,* has proved more resistant, but there has been a reduction of some 80 per cent in their numbers. The whole of the populated coastal belt as well as the mining concerns and other settlements in the interior are under DDT residual protection. In two of the suburbs of Georgetown parasite rates have gone down from

55 per cent to nil, and the spleen rates from 44 per cent to 1.5 per cent. Similar reductions are recorded on the estates. Sprayings are made at intervals of eight months and are made compulsory by law. Complaints have been negligible and authenticated claims for damages have amounted to only $15 in three years.

It must be emphasized that should the protective measures ever be suspended, mosquito infiltration will take place from the hinterland and malaria epidemics may follow.

Latin America

Malaria control, largely by residual house spraying, has spread rapidly in Latin America and in many countries developed into important national programs. The WHO in its survey of DDT protected populations in formerly malarious areas gives 1,500,000 in Argentina, 20,000,000 in Brazil, 375,000 in Mexico, 385,000 in Peru, and 863,000 in Venezuela. Malaria was eradicated from Chile by larval control in 1945.

In Argentina, 2,785 cases of malaria, of which only 134 were new infections, were reported during the first half of 1949 as against about 300,000 cases formerly customary during that part of the year.

Brazil began a vast program of malaria control by DDT in March 1947. An emulsion is the medium most often employed in spraying. In 1947, 200,000 houses were treated. The number grew rapidly to 1 million in 1948, to 2,206,000 in 1949, and to over 3 million in 1950. 3,000 tons of DDT are needed annually at the present scale of operations. The most formidable carrier is *Anopheles darlingi,* but *A. tarsimaculatus* and *A. albitarsis* are also vectors. In the southern part of the country two species of *Kerteszia* not having the decided domestic habits of the *darlingi* are of some importance. It seems, however, that house spraying somewhat interrupts also their transmission. In most DDT controlled areas parasite rates now approach nil.

In Peru, the National Social Security Fund, the National Agrarian Society and industrial employers collaborate in and contribute to the malaria control program. A kerosene solution of DDT is employed, and the program is so lar limited chiefly to the coastal valleys. The principal vector is *Anopheles pseudopunctipennis,* and the season of transmission is short. Parasite rates now range from 0.6 per cent to nil where formerly they were running from 5 to 25 per cent. *Falciparum* infections had completely disappeared after three years' control.

Venezuela has a very important anti-malaria residual spraying program particularly in the hyperendemic Llanos regions which roughly cover the great plains between the Orinoco and the coastal cordillera. The program is now in its fifth year and aims at bringing an area of 233,000 sq. miles under control. In many localities spleen rates were from 80 to 100 per cent before the program was started. In a number of these localities rates of only 3 per cent are now encountered. In three states with about 500,000 inhabitants the malaria mortality was reduced from 173 per 100,000 population in 1941–45 to 5 in 1948. The principal vector, *A. darlingi,* has been radically reduced, but *A. albimanus,* which is second in importance has not shown a measurable reduction.

Conclusions

Malaria control by residual spraying, which is done almost entirely with DDT, has brought health to millions of homes in the tropics and subtropics where the meaning of good health was formerly unknown. The world has never before felt the impact of a health program, so quickly, so dramatically achieved.

First of all, the method is cheap. Malaria is being pushed back in areas where the population was too poor and miserable to dream of malaria conquest by larval control. Perhaps when wealth has been accumulated permanent bonification may get under way. Meanwhile, vast tracts of rich tropical lands will re-enter world economy and that at a negligible cost.

Secondly, these programs can be set in motion and maintained by a very small qualified technical staff, foremen and labor being easily trained. That makes rapid expansion possible, which can hardly be said for any other kind of disease eradication project.

Thirdly, the method is adaptable to nearly all climatic and social conditions. As has been seen in the preceding, nearly all of the anthropophilic mosquitoes are susceptible to this method of control, and other effective vectors are so reduced that transmission becomes rare or ceases. There have been some failures, such as in the Philippines where *Anopheles minimus flavirostris* appears not to roost on sprayed walls, and in Malaya, but means may still be found to deal with such cases.

Today, well over 50 million people depend for their life and working capacity on an adequate supply of DDT. Requests for help present the urgent need of extending this protection to something like 800 million people as fast as possible. An action of this kind extended over ten or twenty years would go a long way toward establishing a huge prosperity sphere of democratic countries.

It is essential, however, to keep in mind that so long as the malaria vectors remain in the hinterland and human carriers travel freely these programs must be kept up. Failure of the DDT supply would not only interrupt the most promising tropical and sub-tropical health improvement ever seen but would also immediately expose millions, who will have lost their immunity, to devastating malaria epidemics. DDT production must not only be kept up but also be kept expanding to meet the growing needs. The free flow of this precious product to all friendly countries and their dependencies must be maintained at all costs. Of this need the WHO is well aware. It has canvassed the world supply and has informed us of the vital role played by producers in this country. Now that DDT is in short supply we must therefore assure an adequate export allotment even though it curtails manufacture of household sprays. Less than 5 per cent of the DDT needed for residual house spraying is on a give-away basis, directly or indirectly. Profit, political necessity and humanitarian intent blend amazingly well in the magic white powder.

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ARTICLES

MOSQUITO CONTROL AGENCIES IN THE UNITED STATES

COMPILED BY H. H. STAGE

Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U.S.D.A.

Information on the location of agencies controlling mosquitoes in the United States, including Alaska, Hawaii, and Puerto Rico, was obtained by means of a questionnaire sent to each state entomologist and state health officer. The details of budget, acreage, and number of people protected were supplied by managers or others in charge of local mosquito-control work. My thanks are due to all these officials for their ready cooperation.

Data for each agency are given in so far as they have been made available for the 1950 season: it is recognized that information on the extent of work is incomplete. Readers are asked to report additional agencies to the compiler. In some instances the size of the control area is given, all of which, of course, is not treated. Only states and territories known to have active mosquito-control work in progress are included in this compilation. The number of people protected is based on summer populations, which in some localities are considerably higher than for the remainder of the year.

The total sum budgeted by the abatement districts and local cities as shown is well over $6,000,000. According to C. A. Hanson and J. H. Bright in a paper, "The National Malaria Eradication Program," read before the National Malaria Society on November 7, 1950, about $2,500,000 additional was spent in 1950 for malaria prevention in the United States. This sum was expended by the cooperating states and federal government and was designed especially for malaria rather than for mosquito control. No doubt this figure will be greatly reduced during the next few years because of the decreasing incidence of the disease. In this list it is shown that more than 26,000,000 persons were protected from mosquito annoyance and in addition over 800,000 homes were treated with residual sprays for the control of malaria.

Figure 1 shows the location of mosquito control operations in the United States.

There are six well-organized state mosquito-control associations in the United States which have formal meetings. They are as follows:

New Jersey Mosquito Extermination Association: Organized in 1913; Bailey B. Pepper, Secretary, New Jersey Agricultural Experiment Station, New Brunswick.

Florida Anti-Mosquito Association: Organized in 1929; John A. Mulrennan, Secretary-Treasury, P. O. Box 210, Jacksonville.

California Mosquito Control Association: Organized in 1932; Ted Aarons, Secretary-Treasurer, Court House, Oakland 7.

Virginia Mosquito Control Association: Organized in 1947; R. E. Dorer, Secretary-Treasurer, 204 Essex Building, Norfolk.

Utah Mosquito Abatement Association: Organized in 1947; Robert A. Wilkins, Secretary-Treasurer, 401 City-County Building, Salt Lake City.

Illinois Mosquito Control Association: Organized in 1949; J. Lyell Clarke, Secretary-Treasurer, 8130 Ogden Avenue, Lyons.

STATISTICS, BY STATES

Alabama — Alabama Department of Public Health, Bureau of Sanitation, Montgomery 4, Arthur N. Beck, State Director, CDCA. (State-wide.) Annual budget, $234,225. Number of homes treated with residual sprays, 71,000.

Arkansas — Arkansas State Board of

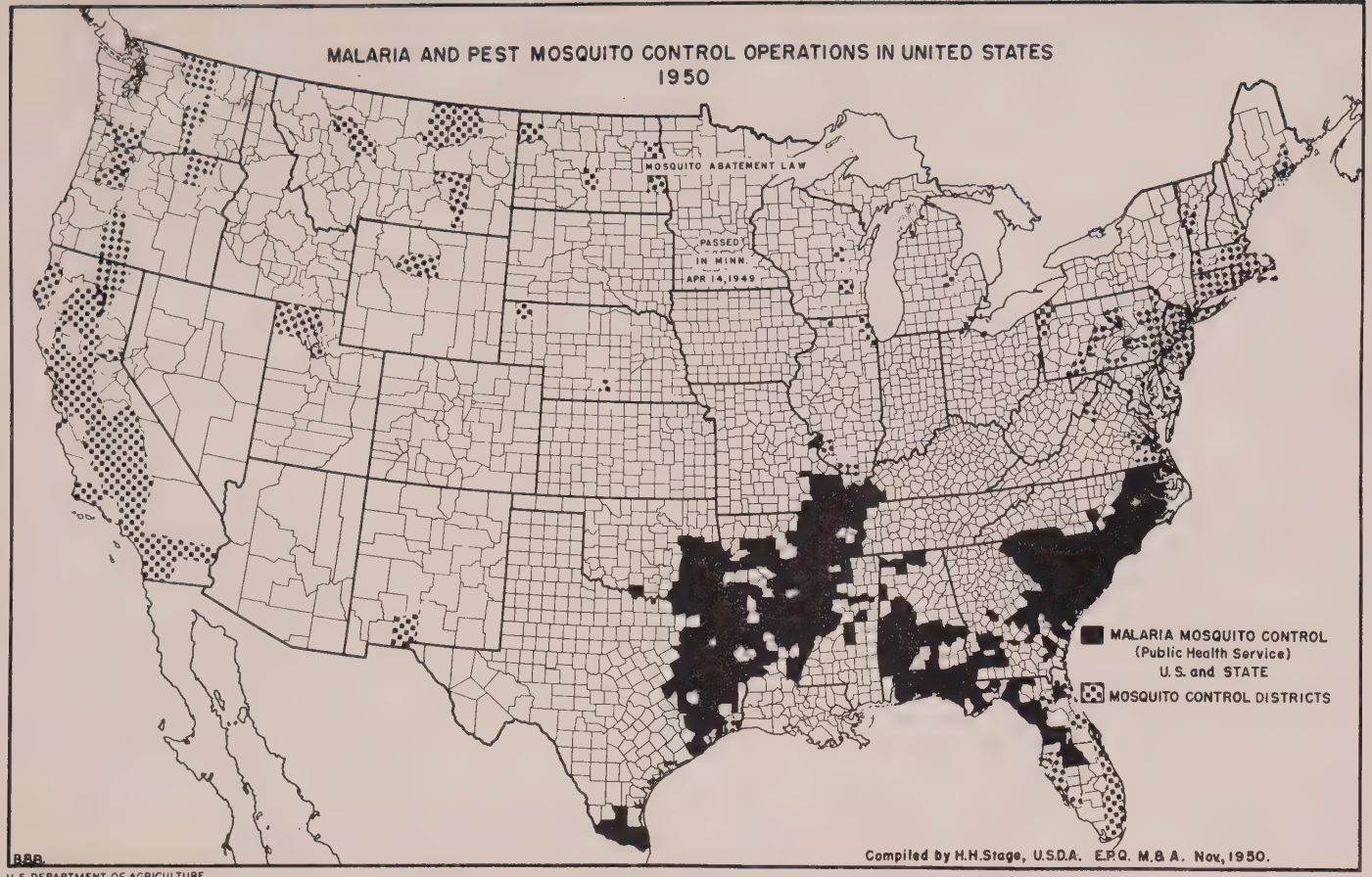

Fig. 1.—Map of the United States showing location of mosquito control operation.

Health, Little Rock, John E. Taylor, State Director, CDCA. (State-wide.) Annual budget, $582,718.24. Number of homes treated with residual sprays, 109,328.

California — Alameda County Mosquito Abatement District, 1-A Court House, Oakland 7, Harold F. Gray, Engineer and Manager. Organized in 1930. Annual budget, $108,588. Area under control, 445 square miles; number of people protected, 700,000.

Anderson Mosquito Abatement District, Anderson, Shasta County, Mrs. Loreva Gill, Secretary. Organized in 1919. Annual budget, $2,955. Area under control, 11 square miles; number of people protected, 1,925.

Ballona Creek Mosquito Abatement District, 2426 Sleepy Hollow Drive, Glendale 6, Los Angeles County, Eugene J. Bumiller, Manager. Organized in 1944. Annual budget, $20,491. Area under control, 24 square miles; number of people protected, 125,000.

Butte County Mosquito Abatement District, 113 "B" St., P. O. Box 233, Biggs, Robert F. Portman, Manager. Organized in 1948. Annual budget, $84,372. Area under control, 1612 square miles; number of people protected, 64,000.

Carpinteria Pest Abatement District, Route 1, Box 29, Carpinteria, Santa Barbara County, F. W. Thomas, Supt. Organized in 1936. Annual budget $1,513. Area under control, 10 square miles; number of people protected, 4,500.

Clear Creek Mosquito Abatement District, Redding, Shasta County, Grover Oaks, President. Organized in 1920. Annual budget $7,133. Area under control, 32 square miles; number of people protected, 2,650.

Coachella Valley Mosquito Abatement District, P. O. Box 427, Indio, Riverside County, F. B. Dozier, Secretary. This district was formed for the purpose of controlling the eye gnat. Mosquito abatement work is incidental. Organized in 1928. Annual budget $18,654. Area under control, 2,084 square miles; number of people protected, 18,000.

Compton Creek Mosquito Abatement District, 200 West Artesia St., Long Beach 5, Los Angeles County, J. O. McDonald, Supt. Organized in 1927. Annual budget $5,799. Area under control, 25 square miles; number of people protected, 45,000.

Consolidated Mosquito Abatement District, 1941 West Front St., P. O. Box 278, Selma, Fresno County, T. G. Raley, Manager. Organized in 1946. Annual budget, $116,429. Area under control, 1047 square miles; number of people protected, 120,000.

Contra Costa Mosquito Abatement District Number 1, P. O. Box 447, 1224 Escobar St., Martinez, Contra Costa Co., Ernest Campbell, Manager. Organized in 1926. Annual budget, $31,276. Area under control, 150 square miles; number of people protected, 108,000.

Corcoran Mosquito Abatement District, P. O. Box 907, Corcoran, Kings and Tulare Counties, L. S. Haile, Manager. Organized in 1947. Annual budget, $12,378. Area under control, 90 square miles; number of people protected, 10,000.

Cottonwood Mosquito Abatement District, P. O. Box 153, Cottonwood, Shasta County, William E. Morgan, Secretary. Organized in 1919. Annual budget, $3,797. Area under control, 14 square miles; number of people protected, 1,450.

Delano Mosquito Abatement District, P. O. Box 457, Delano, Kern and Tulare Counties, J. Manweiler, Supt. Organized in 1944. Annual budget, $25,901. Area under control, 350 square miles; number of people protected, 8,500.

Delta Mosquito Abatement District, 1621 West Houston, Visalia, Tulare County, William D. Murray, Manager. Organized in 1922. Annual budget, $87,367. Area under control, 705 square miles; number of people protected, 80,000.

Durham Mosquito Abatement District, Stanford Road, Durham, Butte County, William Bollerud, Executive Officer. Organized in 1918. Annual budget, $4,306. Area under control, 56 square miles; number of people protected, 1,500.

East Side Mosquito Abatement District, P. O. Box 1023, Yosemite Boulevard and San Juan Avenue, Modesto, Stanislaus County, E. Chester Robinson, Manager. Organized in 1939. Annual budget, $78,173. Area under control, 281 square miles; number of people protected, 81,830.

Eureka Mosquito and Rodent Control Department, P. O. Box 98, City Hall, Eureka, Humboldt County, Brunson P. Bliven, Entomologist. Organized in 1937. Annual budget, $10,000. Area under control, 250 acres; number of people protected, 25,000.

Fresno Mosquito Abatement District, P. O. Box 2, 2338 McKinley Avenue, Fresno, Fresno County, Edward D. Davis, Manager. Organized in 1942. Annual budget, $94,976. Area under control, 302 square miles; number of people protected, 210,000.

Hanford Mosquito Abatement District, P. O. Box 303, Civic Auditorium, Hanford, Kings County, E. M. Russell, Supt. Organized in 1944. Annual budget, $14,932. Area under control, 13 square miles; number of people protected, 10,000.

Kern Mosquito Abatement District, P. O. Box 907, 1418 42nd St., Bakersfield, Kern County, Arthur F. Geib, Manager. Organized in 1916. Annual budget, $130,255. Area under control, 886 square miles; number of people protected, 140,000.

Lake County Mosquito Abatement Distrist, Lakeport, Lake County, J. C. Miller, Secretary, Board of Trustees. Organized in 1948. Annual budget, $16,764. Area under control, 1256 square miles; number of people protected, 12,500.

Los Angeles City Health Department, 116 Temple St., Los Angeles 12, Los Angeles County, Dr. George M. Uhl, City Health Officer. Organized in 1947. Annual budget, $27,377. Area under control, 430 square miles. Number of people protected, 2,000,000.

Los Molinos Mosquito Abatement District, P. O. Box 130, Los Molinos, Tehama County, L. M. Carlson, Supt. Organized in 1917. Annual budget, $6,094. Area under control, 284 square miles; number of people protected, 3,000.

Madera County Mosquito Abatement District, P. O. Box 898, Howard Road, Madera, Gustaf F. Augustson, Manager-Entomologist. Organized in 1946. Annual budget, $52,831. Area under control, 650 square miles; number of people protected, 31,000.

Marin County Mosquito Abatement District, Court House, San Rafael, G. Paul Jones, Supt. Organized in 1915. Annual budget, $26,632. Area under control, 181 square miles; number of people protected, 85,000.

Matadero Mosquito Abatement District, 310 University Avenue, Room 214, Palo Alto, Santa Clara County, Gordon W. Mapes, Supt. Organized in 1917. Annual budget, $17,886. Area under control, 58 square miles; number of people protected, 35,000.

Merced County Mosquito Abatement District, P. O. Box 1269, Santa Fe Drive, Merced, Edgar A. Smith, Manager-Entomologist. Organized in 1923. Annual budget, $166,668. Area under control, 1,995 square miles; number of people protected, 67,000.

Monterey County Health Department, 154 West Alisal St., Salinas, E. W. Munson, Director of Sanitation. Organized in 1947. Annual budget, $8,710. Area under control, 40 square miles; number of people protected, 78,000.

Napa County Mosquito Abatement District, P. O. Bldg., Napa, Arthur M. Emerick, Supt. Organized in 1925. Annual budget, $7,636. Area under control, 790 square miles; number of people protected, 48,000.

Northern San Joaquin County Mosquito Abatement District, P. O. Box 318, 1213 So. Sacramento St., Lodi, Robert H. Peters, Manager. Organized in 1948. Annual budget, $45,308. Area under control, 190 square miles; number of people protected, 33,000.

Orange County Mosquito Abatement District, P. O. Box 87, Santa Ana, Jack H. Kimball, Manager. Organized in 1947.

Annual budget, $130,688. Area under control, 777 square miles; number of people protected, 164,930.

Oroville Mosquito Abatement District, 2083 Elfin St., Oroville, Butte County, Harry R. Flood, Supt. Organized in 1916. Annual budget, $3,966. Area under control, 12 square miles; number of people protected, 14,000.

Pine Grove Mosquito Abatement District, Glenburn, Shasta County, A. Carpenter, Supt. Organized in 1931. Annual budget, $5,435. Area under control, 210 square miles; number of people protected, 1,260.

Pulgas Mosquito Abatement District, P. O. Box 995, 19th and Bayshore Avenues, San Mateo, San Mateo County, C. Donald Grant, Manager-Entomologist. Organized in 1916. Annual budget, $22,816. Area under control, 96 square miles; number of people protected, 85,000.

Redding Mosquito Abatement District, P. O. Box 331, Redding, Shasta County, J. D. Willis, Supt. Organized in 1919. Annual budget, $16,695. Area under control, 21 square miles; number of people protected, 16,000.

Sacramento County-Yolo County Mosquito Abatement District, Room 216-D Court House, Sacramento 14, George Umberger, Supt. Organized in 1946. Annual budget, $93,373. Area under control, 2,019 square miles; number of people protected, 16,213.

San Diego City-County Health Department, Civic Center, San Diego, San Diego County, Dr. J. B. Askew, Health Officer. Organized in 1947. Annual budget, $57,350. Area under control, 4,258 square miles; number of people protected, 857,452.

Solano County Mosquito Abatement District, P. O. Box 304, Suisun Plaza, Suisun, H. C. Pangburn, Supt. Organized in 1933. Annual budget, $25,933. Area under control, 827 square miles; number of people protected, 114,000.

Southern Sonoma Valley Mosquito Abatement District, P. O. Box 56, Sonoma, Sonoma County, Edward Smith, Supt. Organized in 1917. Annual budget, $7,026. Area under control, 216 square miles; number of people protected, 12,000.

Sutter-Yuba Mosquito Abatement District, 925 Market St., Yuba City, Sutter and Yuba Counties, Thomas M. Sperbeck, Supt. Organized in 1946. Annual budget, $35,322. Area under control, 725 square miles; number of people protected, 48,000.

Three Cities Mosquito Abatement District (San Mateo, Burlingame and Hillsborough), P. O. Box 995, 19th and Bayshore Avenues, San Mateo, San Mateo County, C. Donald Grant, Manager-Entomologist. Organized in 1915. Annual budget, $23,744. Area under control, 125 square miles; number of people protected, 83,000.

Tulare Mosquito Abatement District, 467 So. Larkin St., Tulare, Tulare County, Rolland L. Henderson, Manager. Organized in 1944. Annual budget, $47,742. Area under control, 580 square miles; number of people protected, 30,000.

Turlock Mosquito Abatement District, P. O. Box 629, Stanislaus District Fairgrounds, Turlock, Stanislaus County, G. Edwin Washburn, Manager. Organized in 1946. Annual budget, $109,446. Area under control, 966 square miles; number of people protected, 65,000.

West Side Mosquito Abatement District, 214 Buchanan Street, Taft, Kern County, R. H. Coburn, Supt. Organized in 1931. Annual budget, $37,234. Area under control, 1,193 square miles; number of people protected, 37,500.

Connecticut — State Board of Mosquito Control, P. O. Box 1106, 123 Huntington St., New Haven, R. C. Botsford, Supt. Organized in 1915 (State-wide). Annual budget, $70,000. Area under control, 13,000 acres; number of people protected, 1,000,000.

Delaware — Mosquito Control Division, State Highway Department, Lewes, Sussex County, Frank D. Cannon, Supt. Organized in 1935. Annual budget, $75,000. Number of people protected, 50,000.

District of Columbia — District of

Columbia Government, Sewer Division, 2nd and N Streets, S.E., Washington 3, Joseph D. Pallas, Senior Inspector. Organized in 1930. Annual budget, $28,684. Area under control, District of Columbia; number of people protected, 802,176.

Florida — Florida State Board of Health, Division of Entomology, P. O. Box 210, Jacksonville, Duval County, John A. Mulrennan, Director, CDCA (Statewide). Annual budget, $269,158. Number of homes treated with residual sprays, 33,214.

Pest Control Section, Division of Sanitation, City Health Department, 940 Main street, Jacksonville, Duval County, H. D. Peters, Sanitary Engineer. Organized in 1915. Annual budget, $40,000. Area under control, 25,600 acres; number of people protected, 205,000.

Alachua County Health Department, Gainesville, Charles C. Cook, Sanitary Engineer. Organized in 1947. Annual budget, $5,000. Area under control, 2,500 acres; number of people protected, 20,000.

Leon County Health Unit, Sanitary Department, Tallahassee, Ford L. Thompson, Sanitarian. Organized in 1923. Annual budget, $6,800. Area under control, 400 acres; number of people protected, 51,000.

East Volusia County Anti-Mosquito District, P. O. Box 1855, Daytona Beach, V. S. Minnich, Supt. Organized in 1937. Annual budget, $59,000. Area under control, 586 square miles; number of people protected, 45,000.

East Volusia County Anti-Mosquito District, Southern District, 200 Live Oak Street, New Smyrna Beach, William C. White, Supt. Organized in 1938. Annual budget, $25,000. Area under control, 50,000 acres; number of people protected, 25,000.

Lake County Health Department, P. O. Box 247, Tavares, Burke Chester, Supt. Organized in 1950. Annual budget, $26,150. Area under control, 8,500 acres; number of people protected, 36,000.

Brevard County Mosquito Control, Box 42, Titusville, Alvin J. Higginbotham, Director. Organized in 1937. Annual budget, $110,000. Area under control, 50,000 acres; number of people protected, 20,000.

Indian River County Mosquito Control District, P. O. Box 884, Vero Beach, Edward M. Becton, Supt. Organized in 1925. Annual budget, $88,600. Area under control: 12,000 acres with larvicides; 15,000 acres with adulticides; number of people protected, 14,500.

St. Lucie County Mosquito Abatement District, County Court House, North Second St., Fort Pierce, B. Arnold, County Engineer. Organized in 1925. Annual budget, $29,550. Area under control, 25,600 acres; number of people protected, 17,500.

Martin County Mosquito Control District, Stuart, Mark A. Witham, Director and Supervisor. Organized in 1947. Annual budget, $17,000. Area under control, 4,800 acres; number of people protected, 6,000.

Palm Beach County Mosquito Abatement District, P. O. Box 2785, Building T-83, International Airport, West Palm Beach, E. L. Seabrook, Entomologist and Director. Organized in 1941. Annual budget, $68,500. Area under control, 10,000 acres; number of people protected, 114,000.

Broward County Anti-Mosquito District, County Court House, Fort Lauderdale, James H. Bertholf, Director. Organized in 1933. Annual budget, $76,000. Area under control, 15,000 acres; number of people protected, 40,000.

Dade County Anti-Mosquito District, 1909 Dade County Court House, Miami 32, Fred H. Stutz, Director. Organized in 1933. Annual budget, $81,000. Area under control, 8,000 acres ditched; number of people protected, 500,000.

Sarasota County Mosquito Abatement District, County Court House, Sarasota, J. Melton Williams, Supt. Organized in 1945. Annual budget, $44,000. Area under control, 100,000 acres; number of people protected, 27,000.

Manatee County Mosquito Abatement District, Court House, Bradenton, John

W. Patton, Director. Organized in 1950. Annual budget, $25,000. Area under control, 20,000 acres; number of people protected, 35,000.

Hillsborough County Anti-Mosquito Abatement District, 1420 Tampa Street, Tampa, H. B. Crowell, Jr., Supt. Organized in 1950. Annual budget, $47,775. Area under control, 20,000 acres; number of people protected, 215,000.

Pinellas County Anti-Mosquito Abatement District, County Court House, Clearwater, Joe W. Rogers, Supt. Organized in 1931. Annual budget, $49,155. Area under control, 100,000 acres; number of people protected, 157,500.

Fort Myers Mosquito Control District, Fort Myers Beach, Lee County, William I. Tooley, Chairman. Organized in 1950. Annual budget, $17,000.

Anastasia Mosquito Abatement District, P. O. Box 1449, St. Augustine Street, St. Johns County, J. Earl Mickler, Chairman. Organized in 1949. Annual budget, $8,800.

Monroe and Amelia Island Counties voted control districts in 1950 and will probably be in operation in 1952.

Georgia — State Department of Public Health, Atlanta, Fulton County, L. G. Lenart, State Director, CDCA (Statewide). Number of homes treated with residual spray, 91,933.

Illinois — The DesPlaines Valley Mosquito Abatement District, 8130 Ogden Avenue, Lyons, Cook County, J. Lyell Clarke, Sanitary Engineer. Organized in 1927. Annual budget, $80,000. Area under control, 49,000 acres; number of people protected, 235,000.

North Shore Mosquito Abatement District, P. O. Box 55, 62 Skokie Boulevard, Winnetka, Cook County, Thomas J. Lynch, Supt. Organized in 1927. Annual budget, $65,000. Area under control, 150,000 acres; number of people protected, 160,000.

Lake Forest Mosquito Abatement District, 174 Wildwood Road, Lake Forest, Lake County, Stanley C. Owen, Supt. Organized in 1927. Annual budget, $8,000. Area under control, 15 square miles; number of people protected, 7,700.

Highland Park Mosquito Abatement District, Highland Park, Lake County, William C. Heinricks, Supervisor. Organized in 1931. Annual budget, $16,000. Area under control, 18 square miles; number of people protected, 22,000.

Cairo Mosquito Abatement District, 1115 Cedar Street, Cairo, Alexander County, Ralph K. Gibson, Sanitary Engineer. Organized in 1940. Annual budget, $4,500. Area under control, 2,000 acres; number of people protected, 15,000.

Herrin Mosquito Abatement District, Herrin, Williamson County, James Corcoran, Supt. Organized in 1932. Annual budget, $800. Area under control, 4 square miles; number of people protected, 8,000.

East St. Louis Mosquito Abatement District, Dupo, St. Clair County. Annual budget, $20,000. Area under control, 25 square miles; number of people protected, 76,000.

Dupo Mosquito Abatement District, Dupo, St. Clair County. Annual budget, $1,000. Area under control, 8 square miles; number of people protected, 3,000.

Carbondale Mosquito Abatement District, P. O. Box 497, Carbondale, Jackson County, J. L. Burnett, Secretary. Organized in 1935. Annual budget, $2,000. Number of people protected, 12,000.

Freeport Mosquito Abatement District, Freeport, Stephenson County, Wilbur R. Mitchell, Supt. Organized in 1948. Annual budget, $11,000. Area under control, 91 square miles; number of people protected, 25,000.

Louisiana — Louisiana State Health Department, Civil Courts Building, New Orleans, A. B. Ritter, State Director CDCA (State-wide). Number of homes treated with residual sprays, 39,117.

Maine — Cranberry Isles Mosquito Control, Isleford, Hancock County, Frank B. Bartlett. Organized in 1928. Annual budget, $1,000. Number of people protected, 500.

City of Old Orchard Beach, Old Orchard Beach, York County. Annual budget, $1,200. Number of people protected, 20,000.

Massachusetts — Cape Cod Mosquito Control Project, 241 Main St., Hyannis, Barnstable County, Oscar W. Doane, Supt. Organized in 1930. Annual budget, $50,000. Area under control, 51,200 acres; number of people protected, 150,000.

Town of Natick, Board of Health, Main street, Natick, Middlesex County, Joseph P. Foley, Supt. Organized in 1946. Annual budget, $8,500. Area under control, 1,000 acres; number of people protected, 20,000.

Needham Mosquito Control, Board of Health, Town Hall, Needham, Norfolk County, Patrick Tocci, Supt. Organized in 1945. Annual budget, $3,850. Area under control, 8,150 acres; number of people protected, 16,000.

Town of Plymouth Mosquito Control, Plymouth, Plymouth County, Superintendent, State Department of Conservation. Organized in 1942. Annual budget, $750.

City of Quincy Health Department, 1245 Hancock Street, Quincy 69, Norfolk County, Charles Herbert, Commissioner of Public Works. Annual budget, $7,000. Area under control, 10,650 acres; number of people protected, 85,000.

Town of Saugus, Public Works Department, Saugus, Essex County, Charles C. DeFronzo, Supt. Organized in 1947. Annual budget, $1,000. Area under control, 7,400 acres; number of people protected, 17,000.

Town of Framingham, Board of Health, Memorial Building, Framingham, Middlesex County, David Moxon, Agent. Organized in 1947. Annual budget, $5,000. Area under control, 150 acres; number of people protected, 25,000.

Town of Hingham, Board of Health, Hingham, Plymouth County, E. S. Warrell, Executive Health Officer. Organized in 1950. Annual budget, $700. Area under control, 12,000 acres; number of people protected, 11,000.

Town of Lincoln, Board of Health, Lincoln, Middlesex County. Superintendent, Board of Health. Annual budget, $1,000. Area under control, 9,550 acres.

Bristol-South Plymouth Maintenance Project, Box 38, North Dartmouth, Bristol County, Allison H. Shockley, Supervisor. Organized in 1931. Annual budget, $10,000. Number of people protected, 89,000.

Martha's Vineyard Maintenance Project, Box 38, North Dartmouth, Bristol County, Allison H. Shockley, Supervisor. Organized in 1931. Annual budget, $2,225. Area under control, 46,500 acres; number of people protected, 40,000.

City of Boston Health Department, Division of Housing and Sanitation, Haymarket Square, Boston 14, Suffolk County. Organized in 1938. Annual budget, $10,000. Area under control, 29,000 acres; number of people protected, 2,000,000.

Town of Braintree, Highway Department, Union Street, Braintree 85, Norfolk County, John Q. Wentworth, Superintendent. Organized in 1950. Annual budget, $2,000. Area under control, 444 acres; number of people protected, 23,000.

Town of Duxbury, Board of Health, Duxbury, Plymouth County. Annual budget, $1,300. Area under control, 15,700 acres.

Berkshire County Mosquito Control Project, Room 18, Berkshire County Court House, Pittsfield, Archibald F. Cummings, Sr., Supt. Organized in 1945. Annual budget, $54,332. Area under control, 125,000 acres; number of people protected, 186,000.

East Middlesex Mosquito Control Project, Room 301, City Hall, Cambridge, Middlesex County, Robert L. Armstrong, Supt. Organized in 1945. Annual budget, $37,700. Area under control, 36,000 acres; 25,000 catch basins; number of people protected, 440,000.

Nantucket Mosquito Control, 48 West Chester Street, Nantucket, Nantucket County, John H. Kittila, Supt. Organized in 1926. Annual budget, $4,500. Area

under control, 50 miles of ditching; number of people protected, 20,000.

North Shore Maintenance Project, Reclamation Board, State Department of Agriculture, 41 Tremont St., Boston. Organized in 1933. Annual budget, $6,700. Area under control, 20,000 acres; number of people protected, 250,000.

South Shore Mosquito Maintenance Project, Summer Street, Marshfield Hills, Plymouth County, Lyman S. Kent, Supervisor. Organized in 1931. Annual budget, $18,000. Area under control, 13,433 acres; number of people protected, 300,000.

City of Westwood, Board of Health, Westwood, Norfolk County, Albert H. Bryant, Supt. Organized in 1947. Annual budget, $2,000. Area under control, 7,200 acres; number of people protected, 6,000.

Michigan — Saginaw City Health Department, Room 110, City Hall, Saginaw, Saginaw County, Nelson Hall, Supervisor. Organized in 1946. Annual budget, $3,500. Area under control, 17 square miles; number of people protected, 97,000.

City of Monroe, Monroe, Monroe County, L. Ray Servis, Supt. Organized in 1946. Annual budget, $2,000. Area under control, 8 square miles; number of people protected, 23,000.

Minnesota — State of Minnesota, Department of Agriculture, Dairy and Food, 301 Coffey Hall, Bureau of Plant Industry, University Farm, St. Paul 1, A. W. Buzicky, Associate State Entomologist.

Several towns have adult mosquito control programs with the work being carried out under contract with commercial operators utilizing aircraft or fog generators. A mosquito abatement law has been passed and communities undoubtedly will take advantage of it in the near future.

Mississippi — Mississippi State Board of Health, Jackson, H. A. Kroeze, State Director, CDCA (State-wide). Annual budget, $240,000. Number of homes treated with residual sprays, 111,063.

Missouri — Missouri State Department of Health, Jefferson City, W. Scott Johnson, State Director, CDCA (State-wide). Annual budget, $108,990. Number of homes treated with residual spray, 24,029.

Missouri State Department of Health, Malden Municipal Airport, Malden, Milfred D. Plummer, Malaria Control Specialist, CDCA (State-wide). Annual budget, $115,260. Number of homes treated with residual sprays, 23,149.

Montana — City of Great Falls, City-County Health Department, Great Falls, Cascade County, William Shea, Sanitarian. Organized in 1922. Annual budget, $4,505. Area under control, 2,747 square miles; number of people protected, 55,500.

City of Malta Mosquito Control, Malta, Phillips County, R. G. Monroe, Mayor. Organized in 1948. Annual budget, $3,000. Area under control, 640 acres; number of people protected, 3,000.

City of Glasgow Mosquito Control, Glasgow, Valley County, R. C. Fargo, City Engineer. Organized in 1948. Annual budget, $2,000. Area under control, City of Glasgow; number of people protected, City of Glasgow.

Choteau Chamber of Commerce, Choteau, Teton County, President, Chamber of Commerce. Organized in 1941. Annual budget, $250. Area under control, 640 square miles; number of people protected, 1,900.

Nebraska — City of Chadron, Chadron, Dawes County, R. C. O'Reilly, City Manager. Annual budget, $150. Area under control, 3.5 acres; number of people protected, 5,000.

City of Holdrege, Holdrege, Phelps County. Organized in 1948. Annual budget, $1,300.

New Hampshire — Hampton Beach Precinct, 62 Marsh Avenue, Hampton Beach, Rockingham County, A. R. Bragg, Treasurer. Organized in 1947. Annual budget, $730. Area under control, 1.5 square miles; number of people protected, 25,000.

New Jersey — Atlantic County Mosquito Extermination Commission, 5 South Virginia Avenue, Atlantic City, Fred A. Reiley, Supt. Organized in 1912. Annual budget, $33,616. Area under control,

121,000 acres; number of people protected, 395,000.

Bergen County Mosquito Extermination Commission, Room 420, Administrative Building, Hackensack, Vernon Conant, Supt. Organized in 1914. Annual budget, $67,000. Area under control, 8,000 acres salt marsh; 241 square miles upland; number of people protected, 540,000.

Burlington County Mosquito Extermination Commission, County Office Building, High and Union Streets, Mount Holly, Earle D. Potter, Supt. Organized in 1931. Annual budget, $20,000. Area under control, 10,000 acres; number of people protected, 106,000.

Cape May County Mosquito Extermination Commission, R.F.D. 1154, Court House, Cape May, Boyd M. Lafferty, Executive-Secretary. Organized in 1915. Annual budget, $14,590. Area under control, 56,300 acres; number of people protected, 443,000.

Essex County Mosquito Extermination Commission, 226 Morris Avenue, Newark 3, George W. Eager, Supt. Organized in 1912. Annual budget, $168,200. Area under control, 8,700 acres; number of people protected, 1,000,000.

Hudson County Mosquito Extermination Commission, 921 Bergen Avenue, Jersey City, Frank D. Donovan, Acting Secretary. Organized in 1912. Area under control, 12,000 acres; number of people protected, 700,000.

Mercer County Mosquito Extermination Commission, Court House, Trenton 10, Harold G. Black, Supt. Organized in 1912. Annual budget, $22,200. Area under control, 144,640 acres; number of people protected, 220,000.

Middlesex County Mosquito Extermination Commission, P. O. Box 346, Parsonage Road, Metuchen, Lester W. Smith, Supt. Organized in 1914. Annual budget, $45,000. Area under control, 7,000 acres saltmarsh; 65 square miles upland; number of people protected, 200,000.

Monmouth County Mosquito Extermination Commission, 54 Broad Street, Red Bank, Samuel Smith, Supt. Organized in 1914. Annual budget, $25,000. Area under control, 12,110 breeding spots; number of people protected, 662,000.

Morris County Mosquito Extermination Commission, 3 Franklin Place, Morris Plains, Roy Wilson, Supt. Organized in 1927. Annual budget, $35,000. Number of people protected, 200,000.

Ocean County Mosquito Extermination Commission, Manahawkin, Stephen Johnson, Supt. Organized in 1916. Annual budget, $40,000. Area under control, 45,000 acres.

Passaic County Mosquito Extermination Commission, County Administration Bldg., Hamilton and Ward Streets, Paterson 1, John Flynn, Supt. Organized in 1912. Annual budget, $38,500. Area under control, 120,000 acres; number of people protected, 340,000.

Somerset County Mosquito Extermination Commission, Court House, Somerville, Robert McChesney, Supt. Organized in 1945. Annual budget, $17,000. Area under control, 305 square miles; number of people protected, 65,000.

Sussex County Mosquito Extermination Commission, Sussex and Merchants National Bank Bldg., Newton, L. P. Dolan, Secretary. Organized in 1925. Annual budget, $1,000.

Union County Mosquito Extermination Commission, 324 North Avenue, East Cranford, George E. Powers, Supt. Organized in 1912. Annual budget, $94,000. Area under control, 100 square miles; number of people protected, 420,000.

Passaic Valley Dredging Program (Essex and Morris Co. Mosquito Extermination Comm.), 3 Franklin Place, Morris Plains, Robert L. Vannote, Supt. Organized in 1938. Annual budget, $33,000. Area affected, 14,000 acres; number of people protected, 1,250,000.

New Mexico — Dona Ana County Health Department, Las Cruces, H. T. Miller, Sanitarian. Organized in 1927. Annual budget, $6,000. Area under control, 250 acres; number of people protected, 30,000.

New York — Suffolk County Mosquito

Control Commission, Yaphank Avenue, Yaphank, Long Island, C. T. Williamson, Supt. Organized in 1933. Annual budget, $214,000. Area under control, 50,000 acres; number of people protected, 300,000.

Nassau County Department of Public Works, Mosquito Control Division, 411 South Grove Street, Freeport, Long Island, LeRoy Kinsey, Deputy Commissioner. Organized in 1916. Annual budget, $600,000. Area under control, 274 square miles; number of people protected, 660,000.

City of Schenectady, City Hall, Schenectady County, Morris M. Cohn, Public Health Engineer. Organized in 1944. Annual budget, $5,500. Area under control, 400 acres; number of people protected, 100,000.

North Carolina — North Carolina State Board of Health, Raleigh, Charles M. White, State Director, CDCA (Statewide). Annual budget, $75,000. Number of homes treated with residual sprays, 73,000.

North Dakota — City of Fargo Health Department, 6 Roberts Street, Fargo, Cass County, C. L. Bradley, Senior Sanitarian. Organized in 1945. Annual budget, $4,000. Area under control, 2,000 acres; number of people protected, 40,000.

City of Grand Forks Health Department, Grand Forks, Grand Forks County, Marvin W. Dehn. Organized in 1946. Annual budget, $300. Number of people protected, 30,000.

Upper Missouri Health District, Williston, Williams County, Dr. Alan K. Johnson, District Health Officer. Organized in 1947. Annual budget, $17,856. Area under control, 1,000 acres; number of people protected, 12,000.

Bismarck Mosquito Control, Bismarck Department of Health, Bismarck, Burleigh County, Dr. P. L. Owens, Supt. Organized in 1945. Area under control, 450 acres.

Ohio — Toledo Area Sanitary District, 5015 Stickney Avenue, Toledo 12, Lucas County, Dr. H. A. Crandall, Supt. Organized in 1945. Annual budget, $130,000. Area under control, 150 square miles; number of people protected, 375,000.

Oklahoma — Oklahoma State Department of Health, 3400 North Eastern, Oklahoma City 5, G. F. Mathews, Commissioner. Number of homes treated with residual sprays, 34,334.

Oregon — City of Portland, Multnomah County Mosquito Control, Bureau of Insect Control, 6525 Southwest, Capitol Hill Road, Portland, Arthur H. Woody, Insect Abatement Supervisor. Organized in 1929. Annual budget, $36,243.60. Area under control, 47,000 acres; number of people protected, 468,500.

Umatilla County Health Department, Box 20, Pendleton, R. H. Wilson, Health Officer. Organized in 1948. Annual budget, $8,000. Area under control, 4,500 acres; number of people protected, 23,000.

Sweet Home Service Club Mosquito Control, Sweet Home, Linn County, Fred Farrier, Supt. Organized in 1950. Annual budget, $1,200. Area under control, 400 acres; number of people protected, 4,000.

Pennsylvania — Delaware County Mosquito Extermination Commission, Court House, Media, R. W. Gies, Director. Organized in 1936. Annual budget, $50,000. Area under control, 185 square miles; number of people protected, 415,000.

Blair County Mosquito Extermination Commission, Hollidaysburg, Lewis Gwin, Director. Organized in 1936. Annual budget, $15,000. Area under control, 425 square miles; number of people protected, 175,000.

City of Philadelphia, Public Works, Philadelphia, Paul McMurray, Director. Organized in 1925. Annual budget, $35,000. Area under control, 30 square miles; number of people protected, 105,000.

U. S. Philadelphia Navy Base, Navy Base and Naval Hospital, J. D. Hillpot, Chief Warrant Officer. Organized in 1941. Annual budget, $12,000. Area under control, 4 square miles; number of people protected, 20,000.

City of Bristol, Bristol, Bucks County, Herman Silber, Director. Organized in

1950. Annual budget, $3,000. Area under control, 8 square miles; number of people protected, 26,000.

City of Hazelton, Hazelton, Luzerne County, Paul LaMonte, Director. Organized in 1940. Annual budget, $4,000. Area under control, 8 square miles; number of people protected, 30,000.

City of Allentown, Health Department, Lehigh County. Organized in 1946. Annual budget, $1,200. Area under control, 10 square miles; number of people protected, 100,000.

Borough of Sayre, Sayre, Bradford County, C. E. Harper, Director. Organized in 1950. Annual budget, $2,000. Area under control, 6 square miles; number of people protected, 8,500.

Borough of Phillipsburg, Phillipsburg, Centre County, Hugh Green, Director. Organized in 1947. Annual budget, $4,000. Area under control, 5 square miles; number of people protected, 5,000.

Pottstown Chamber of Commerce, Pottstown, Montgomery County, Dr. John Miller, Director. Organized in 1947. Annual budget, $1,200. Area under control, 5 square miles; number of people protected, 20,000.

City of Gettysburg, Gettysburg, Adams County, F. H. Himmelbaugh, Director. Organized in 1948. Annual budget, $1,500. Area under control, 5 square miles; number of people protected, 5,000.

City of Morrisville, Morrisville, Bucks County, William Howell, Secretary. Organized in 1950. Annual budget, $1,000. Area under control, 4 square miles; number of people protected, 10,000.

City of Somerset, Somerset, Somerset County, Borough Secretary. Organized in 1947. Annual budget, $600. Area under control, 3 square miles; number of people protected, 4,000.

City of Buck Hill Falls, Buck Hill Falls, Monroe County, C. M. Reese, Director. Organized in 1935. Annual budget, $2,500. Area under control, 10 square miles; number of people protected, 2,000.

Presque Isle State Park, Erie, Erie County, Millard Davis, Director. Organized in 1949. Annual budget, $1,000. Area under control, 7 square miles; number of visitors protected, 500,000.

Borough of Chambersburg, Chambersburg, Franklin County, C. E. Pfouts, Engineer. Organized in 1948. Annual budget, $500. Area under control, 5 square miles; number of people protected, 25,000.

City of Lock Haven, Lock Haven, Clinton County, City Health Officer. Organized in 1949. Annual budget, $800. Area under control, 3 square miles; number of people protected, 20,000.

Oreland Civic Association, Oreland, Montgomery County, Mr. Longstreth, Director. Organized in 1949. Annual budget, $500. Area under control, 2 square miles; number of people protected, 2,000.

City of Grove City, Grove City, Mercer County, Dr. W. W. Sweezy, Director. Organized in 1948. Annual budget, $600. Area under control, 3 square miles; number of people protected, 8,000.

Middletown Air Depot, Middletown, Dauphin County, Colonel W. Kelly, Director. Organized in 1948. Annual budget, $1,000. Area under control, 2 square miles; number of people protected, 12,000.

Rhode Island—Rhode Island matches city and town funds and all mosquito control work is under general State supervision.

Rhode Island Department of Agriculture, 310 State House, Providence, William V. Bartosewitz, Supt. Organized in 1932. Annual budget, $30,000. Area under control, 6,000 acres; number of people protected, 65,000.

Town of Barrington, Barrington, Bristol County, Brooks Hawkins, Supt. Organized in 1934. Annual budget, $3,000. Area under control, 5,400 acres; number of people protected, 7,000.

Town of Bristol, Bristol, Bristol County, Joseph F. Pannone, Supt. Organized in 1935. Annual budget, $3,500. Area under control, 6,300 acres; number of people protected, 13,000.

City of Central Falls, Central Falls, Providence County, Edmond R. Robert, Supt. Organized in 1948. Annual budget, $1,500. Area under control, 600 acres; number of people protected, 3,200.

Camp Fire Girls, Town of Charleston, Washington County, Linton Brown, Supt. Organized in 1945. Annual budget, $200. Area under control, 35 acres; number of people protected, 400.

Town of Narragansett, Narragansett, Washington County, Arthur E. Miller, Supt. Organized in 1946. Annual budget, $1,500. Area under control, 9,300; number of people protected, 5,000.

City of Newport, Health Department, City Hall, Newport, Newport County, Dr. Norman MacLeod, Supt. Organized in 1945. Annual budget, $3,000. Area under control, 2,700; number of people protected, 32,000.

Town of New Shoreham, New Shoreham, Newport County, George C. Sheffield, Supt. Organized in 1949. Annual budget, $1,000. Area under control, 2,000 acres; number of people protected, 1,500.

Town of North Kingston, Town Hall, North Kingston, Washington County, Charles Northrup, Supt. Organized in 1940. Annual budget, $1,500. Area under control, 9,200 acres; number of people protected, 4,700.

City of Pawtucket, City Hall, Pawtucket, Providence County, William Fortin, Supt. Organized in 1946. Annual budget, $3,000. Area under control, 1,500 acres; number of people protected, 6,700.

City of Providence, City Hall, Providence, Providence County, Elmer Ballou, Supt. Organized in 1924. Annual budget, $12,000. Area under control, 12,000 acres; number of people protected, 255,000.

City of Portsmouth, Town Hall, Portsmouth, Newport County, Arthur Sherman, Supt. Organized in 1937. Annual budget, $1,300. Area under control, 4,200 acres; number of people protected, 6,000.

Town of Smithfield, Smithfield, Providence County, Margaret A. Crepeau, Supt. Organized in 1947. Annual budget, $150. Area under control, 65 acres; number of people protected, 350.

Town of Warren, Warren, Bristol County, Anthony Maderios, Supt. Organized in 1937. Annual budget, $800. Area under control, 4,198 acres; number of people protected, 8,000.

City of Warwick Neck, Warwick Neck, Kent County, Robert C. Barber, Supt. Organized in 1936. Annual budget, $1,500. Area under control, 2,300 acres; number of people protected, 28,000.

Town of Westerly, Westerly, Washington County, Frank Terisi, Supt. Organized in 1932. Annual budget, $1,000. Area under control, 8,500 acres; number of people protected, 12,000.

Town of West Warwick, West Warwick, Kent County, Henry Petraca, Supt. Organized in 1939. Annual budget, $2,500. Area under control, 5,200 acres; number of people protected, 19,000.

City of Woonsocket, Woonsocket, Providence County, Charles E. Nicholson, Supt. Organized in 1939. Annual budget, $9,050. Area under control, 5,000 acres; number of people protected, 50,000.

South Carolina — State Board of Health, Columbia, Dr. G. E. McDaniel, State Director, CDCA (State-wide). Annual budget, $459,500. Number of homes treated with residual sprays, 171,941.

South Dakota — A preliminary draft of mosquito control regulations has been drawn up, but at present no mosquito control programs are operating in the state.

Tennessee — Department of Public Health, Nashville, Dr. C. B. Tucker, State Director, CDCA (State-wide). Annual budget, $130,596. Number of homes treated with residual sprays, 26,888.

Texas — State Department of Health, Austin, C. H. Billings, Acting Assistant State Director, CDCA (State-wide). Number of homes treated with residual sprays, 76,521.

Jefferson County Mosquito Control Commission, Beaumont, Albert L. Lafferty, Supt. Organized in 1950. Annual budget, $92,000. Area under control,

124,000 acres; number of people protected, 200,000.

Utah — Salt Lake City Mosquito Abatement District, 401 City and County Bldg., Salt Lake County, Robert A. Wilkins, Manager. Organized in 1924. Annual budget, $52,000. Area under control, 101 square miles; number of people protected, 185,000.

Magna Mosquito Abatement District, Box 6, Magna, Salt Lake County, O. C. Finley, Supt. Organized in 1946. Annual budget, $12,000. Area under control, 100 square miles; number of people protected, 15,000.

Weber County Mosquito Abatement District, 2441 Grant Avenue, Ogden, Dr. Orson Whitney Young, Supt. Organized in 1947. Annual budget, $32,000. Area under control, 1,500 acres; number of people protected, 80,000.

Box Elder County Mosquito and Fly Abatement District, 53 South 6th West, Brigham City, Karl L. Josephson, Supervisor. Organized in 1945. Annual budget, $21,000. Area under control, 5,000 acres; number of people protected, 25,000.

Vermont — Brandon Organization for Mosquito Control, Brandon, Rutland County, Thomas J. Maroney, Supt. Organized in 1945. Annual budget, $1,000. Number of people protected, 2,500.

Lake Dunmore Improvement Association, Brandon, Gladys C. Britten, Supt. Organized in 1935. Annual budget, $500. Area under control, 1,000 acres; number of people protected, 1,000.

Virginia — Virginia Beach-Princess Anne County Mosquito Control Commission, Town Hall, Virginia Beach, R. G. Carter, Supt. Organized in 1940. Annual budget, $25,000. Area under control, 4,000 acres; number of people protected, 50,000.

Kempsville Mosquito Control Commission, Box 321, Route 1, Bayside, Princess Anne County, E. R. Hines, Secretary-Treasurer. Organized in 1948. Annual budget, $2,800. Area under control, 1,700 acres; number of people protected, 8,000.

Tanners Creek Mosquito Control Commission, P. O. Box 1576, Norfolk, Norfolk County, George W. Hackworth, Supt. Organized in 1948. Annual budget, $14,000. Area under control, 7,000 acres; number of people protected, 40,000.

South Norfolk Mosquito Control Commission, Essex Bldg., Norfolk, Norfolk County, R. E. Dorer, Supt. Organized in 1949. Annual budget, $4,000. Area under control, 1,400 acres; number of people protected, 13,000.

Portsmouth City Mosquito Control Commission, City Health Department, Portsmouth, Norfolk County, A. P. Page, Jr., Supt. Organized in 1947. Annual budget, $15,000. Area under control, 7,000 acres; number of people protected, 70,500.

Norfolk City Mosquito Control Commission, Municipal Bldg., Norfolk, Norfolk County, Perry W. Ruth, Technical Advisor. Organized in 1946. Annual budget, $66,000. Area under control, 23,800 acres; number of people protected, 182,500.

Suffolk Mosquito Control Commission, Town Hall, Suffolk, Nansemont County, Lee Everett, Sanitary Officer. Organized in 1948. Annual budget, $3,000. Area under control, 2,200 acres; number of people protected, 12,000.

Franklin Mosquito Control Commission, Town Hall, Franklin, Southampton County, R. E. Dorer, Supt. Organized in 1949. Annual budget, $4,000. Area under control, 1,300; number of people protected, 8,000.

Elizabeth City County Mosquito Control Commission, P. O. Box 106, Hilton Village, N. S. Beaton, Sr., Supt. Organized in 1945. Annual budget, $15,800. Area under control, 25,000 acres; number of people protected, 54,500.

Warwick County Mosquito Control Commission, P. O. Box 106, Hilton Village, N. S. Beaton, Sr., Supt. Organized in 1946. Annual budget, $19,000. Area under control, 45,000 acres; number of people protected, 39,000.

Williamsburg Mosquito Control Commission, Town Hall, Williamsburg, James

City County, Hugh B. Rice, City Manager. Organized in 1947. Annual budget, $3,000. Area under control, 800 acres; number of people protected, 14,000.

City of Petersburg, Health Department, Petersburg, Dinwiddie County, J. L. Spain, Senior Sanitarian. Organized in 1935. Annual budget, $595. Area under control, 60 catch basins and 23 streams; number of people protected, 35,000.

Richmond City Health Department, Rodent and Insect Control, 108 West Cary Street, Richmond, W. H. Gill, Supt. Organized in 1947. Area under control, 770 acres; number of people protected, 238,000.

Washington—Skamania County Mosquito Control, Beacon Rock State Park, Stevenson, C. B. Hadley, Supt. Organized in 1930. Annual budget, $2,000. Area under control, 2,500 acres; number of people protected, 19,000.

Clark County Health Department, Vancouver, George Hutton, Supt. Organized in 1947. Annual budget, $5,000. Area under control, 14,000 acres; number of people protected, 84,700.

Cowlitz County Mosquito Control, Cowlitz County Health Department, Kelso, Joe Walker, Sanitarian. Organized in 1948. Annual budget, $10,000. Area under control, 22,000 acres; number of people protected, 51,200.

Grant County Mosquito Control, County Health Unit, Ephrata.

Four local communities, Moses Lake, Coulee City, Hartline and Wilson Creek are doing a certain amount of mosquito control. Information on these units may be obtained by writing the mayors of these cities.

Hanford Works Mosquito Control Committee, Richland, Benton County, L. G. Koch, Supt. Organized in 1945. Area under control, 5,000 acres; number of people protected, 30,000.

Wisconsin — City of Horicon Mosquito Control, Horicon, Dodge County, L. D. Erdman, Supt. Organized in 1948. Annual budget, $2,000. Area under control, 1,000 acres; number of people protected, 2,800.

City of New London Mosquito Control, New London, Waupaca County, Dr. George Kopp, Supt. Organized in 1947. Annual budget, $3,500. Area under control, 310 acres; number of people protected, 5,000.

Wyoming — City of Thermopolis-Hot Springs County Mosquito Control District, Thermopolis, Bill Virgin, Supt. Organized in late 1920's. Annual budget, $600. Area under control, 300 acres; number of people protected, 4,000.

City of Worland, Jay Cee's, Worland, Washakie County, Robert Smith, Supervisor. Annual budget, $500.

Hawaii — Bureau of Mosquito Control, Territorial Department of Health, P. O. Box 3378, Honolulu, Dr. Stephen M. K. Hu, Supt. Organized in 1943. Annual budget, $100,000. Area under control, 6,435 square miles; number of people protected, 527,500.

Puerto Rico — Bureau of Malaria and Insects Control, Department of Health, Santurce, Engineer Felix C. Garcia, Chief. Organized in 1925. Annual budget, $317,000. Area under control, 80,000 acres; number of people protected, 800,000.

PRELIMINARY FIELD OBSERVATIONS ON THE BEHAVIOR OF THE ADULTS OF *ANOPHELES FRANCISCANUS* McCRACKEN IN SOUTHERN CALIFORNIA

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Introduction. *Anopheles franciscanus* McCracken 1904 is an extremely common mosquito in Southern California, especially during late summer and early autumn. It utilizes almost any type of available water for breeding but reaches its highest larval densities in drying pools with dense algal growth. Favorable breeding places are frequently available for this species in heavily populated areas. At the present time no effort is made to control *A. franciscanus,* largely on the assumption that this species is not anthropophilic. Actually practically nothing is known about the habits of the adults except for their occurrence in such artificial diurnal shelters as culverts and bridges (Freeborn 1949).

Because of the high larval densities attained by this species in proximity to concentrations of human population, it appeared desirable to obtain some information on the habits of the adults, particularly since on June 10, 1950, one of us (J.N.B.) was bitten by four *A. franciscanus* at Imperial Dam, Imperial County, Calif., in an area where larval densities of this species were apparently very low. A check with field men engaged in mosquito control in Los Angeles for a number of years revealed that the attraction of *A. franciscanus* to humans had been noted by them but no definite records or controlled observations had been made to determine the importance of this species. Such unorthodox behavior on the part of a mosquito generally believed to be innocuous throughout its range also pointed to the possibility that the species in Southern California might be a different member of the *pseudopunctipennis* complex, some of which are strongly anthropophilic and serious malaria vectors. Previous investigations had indicated, as summarized by Aitken (1945), that *A. franciscanus* exhibits remarkable variability in the egg stage as well as in the male genitalia, but no correlation had been established between these characters or with the habits of the different forms.

In the course of routine mosquito control activities of the Los Angeles City Health Department, an artificial lake supporting a very high population of *A. franciscanus* was located within the city limits and presented us with an opportunity to observe some phases of the behavior of this species for a period of four weeks, from July 20 to August 16, 1950. Since the lake and surrounding park area were used for the filming of motion pictures our observations were interrupted and finally discontinued before the completion of the projected plans, which we hope to realize in subsequent seasons. Nevertheless we are presenting these preliminary observations at this time as they may be of interest to workers engaged on mosquito control in this area.

Acknowledgments. We are indebted to Mr. R. V. Lee, the owner of the lake where our observations were made, for gracious permission to use the area. We also wish to thank the officers of the Pierce School of Agriculture for the loan and the transportation of animals. To the mosquito control personnel of the Los Angeles City Health Department we are grateful for volunteer help with the landing and biting records.

Locality and Breeding. The artificial lake, known locally as Lee's Lake, is situated in a natural draw southwest of and downstream from Chatsworth Reservoir in the San Fernando Valley in the City of Los Angeles (Fig. 1). It has a

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FIG. 1.—Aerial photograph of Lee's Lake, showing the location of observation points. The density of the park area is not apparent as the photograph was taken in March. (Photo by Fairchild Aerial Surveys, Inc.)

surface area of slightly under six acres and a general depth of three or four feet. It is kept at almost a constant level throughout the year through a balance between inflow and evaporation. The banks of the lake are periodically mowed but abundant marginal vegetation is present throughout the warmer months. The dominant marginal vegetation consists of several grasses, *Juncus* sp., *Scirpus* sp., and restricted areas of *Jussiaea californica.* During the summer months, beds of *Potamogeton pectinatus* cover almost the entire surface of the lake. At this time a dense growth of filamentous algae, largely *Oedogonium,* is produced in the *Potamogeton* beds as well as in the marginal vegetation, forming a mat over the lake. Blue green algae, desmids and colonial green algae are extremely numerous in these mats. At the time of these observations over 100,000 square feet of the lake surface afforded ideal breeding for *A. franciscanus.* Larval densities varied from 20 to over 100 per square foot and an average of 10 pupae per square foot were found. Since the pupal stage of this species lasts about 36 hours, a conservative estimate of the number of adults emerging daily during this time would be 500,000.

For a width varying from a few feet to over 100 yards, the area surrounding the lake is planted as an open landscaped park, which is periodically watered by sprinklers. At the south end there is a continuation of the natural draw occupied by the lake.

This draw is densely wooded and overgrown with weeds and during the period of observation was entirely dry. To the east of the draw is an irrigated pasture harboring cattle at night. At the south end of the lake is a 12′ x 12′ footbridge over a ditch from a small overflow dam. At the narrowed northern part of the lake is a vehicular wooden bridge with a "stone" papier-maché facing. To the west of this bridge is a movie-set cottage and stable also faced with papier-maché "stone."

Diurnal Shelters. Almost every protected, shaded situation within 300 yards of the lake revealed resting *A. franciscanus* during the day. They were noted on tree trunks, under fallen logs, in stumps, brush, clumps of grasses, in depressions and excavations in the ground and in various artificial situations such as under the two bridges, in a concrete culvert, in metal tanks and in wooden crates. The largest number were found in the movie-set cottage which offered a multitude of protected nooks and crannies on its face as well as in the scaffoldings. It is noteworthy that numerous specimens were seen in somewhat exposed situations such as the shaded sides of the vehicular bridge, on tree trunks and in the doorways of the cottage, resembling in this respect *Anopheles crucians* Wiedemann.

No attempt was made to count or even estimate the number of adults present around the lake because of the difficulties in sampling. Males appeared to outnumber females in the ratio of 2 to 1 in the majority of resting places. We were surprised at the small number of gravid females and the almost complete absence of recently blooded females resting near the lake. Unengorged and non-gravid females outnumbered them approximately ten to one. Since this indicated that, in all probability, blooded females rested for one or more days in the vicinity of the area where they secured their blood meal, a survey was made of farm buildings and houses within a mile radius of the lake. No *A. franciscanus* were found beyond one-half mile from the lake, but within this radius small numbers of freshly blooded females were found in various buildings. We are aware that these observations do not agree with the usual finding of large numbers of gravid and blooded females in proximity to breeding sites in other areas of Los Angeles as well as elsewhere in California. With the very heavy population produced in this lake and the readily available cattle blood in the nearby pasture, we had expected to find large numbers of blooded females at least in the shaded draw. It appears that at least in this case, freshly blooded females either utilized a different type of diurnal shelter which we were unable to locate, or secured their blood meals beyond the area checked.

Crepuscular and Nocturnal Activities. On the evening and night of July 25–26, one of us (J.N.B.) spent a 12 hour period, from 6 P.M. to 6 A.M., at the foot bridge near the outlet of the lake observing the activities of the adults of *A. franciscanus*. At 6 P.M. an estimated 500 females and 1,000 males were resting under this bridge. At 8 P.M. they first began to show restlessness and gradually moved out. At this time two females landed on the arm but did not attempt to bite, although given the opportunity. The flashing of a light induced a pseudo-swarming of the males. At 8:15 all but a few individuals had disappeared from the bridge. A gasoline lantern was set up some 75 feet from the bridge at 8:30 and was kept burning throughout the night. No mosquitoes came to the light and only a single female landed on the arm without biting at 9 P.M. At 9:15 P.M. the interior of the car used on the trip was checked and was found to contain 25 females and 46 males resting on the upholstery. The underside of the car had a much larger number of mosquitoes, estimated at 350. The mosquitoes remained in and under the car to the end of the observations in the morning. At that time one freshly blooded female was noted within the car. No mosquitoes were noted under the bridge until 5:40 A.M. and by 6 A.M. approxi-

mately the same number were present as on the previous evening. We believe that the activities of the mosquitoes were affected on this particular night by the brilliant moonlight and the particularly low temperature.

On four other occasions we checked the time of the beginning of the evening flight. It appears to start when the light intensity falls to about 50 Weston units. Apparently not all mosquitoes participate in the flight on a given evening since a small number were always found in the diurnal resting places, usually in more exposed situations. As indicated below this species appears to be at least moderately attracted to artificial lights under favorable environmental conditions. In the morning the return to diurnal shelters appears to take place when light intensities rise to about 50 Weston units.

SWARMING AND MATING. On August 4, a swarm of males was noted for the first time over the roof of the cottage at 7:56 P.M. At this time it was fully formed at a height of some thirteen feet above the ground and approximately one foot above the roof of the porch. Another swarm was noted over the roof of the attached stable at a height of over 15 feet above the ground.

On August 7, 8, 10, and 14, swarms were observed in exactly the same locations and in addition a very large swarm was seen over the top of the roof, approximately 25 feet above the ground. Our observations were concentrated on these three large swarms but several smaller swarms were noted within 100 yards. Table 1 indicates the data we were able to gather on the time, light intensity, and temperature prevalent at the occurrence of the swarm over the porch.

An attempt was made to photograph this swarm. Due to the failure of the synchronization of the flash apparatus the photographs of the entire swarm are not sufficiently clear for reproduction. Fig. 2 shows a close-up of the central part of a swarm. It seems probable that with proper lighting equipment motion pictures may be taken to study the complex movements which take place in swarming.

Since, to our knowledge, the swarming of *A. franciscanus* has not been described before and that of other anophelines seldom seen in nature, it appears worthwhile to describe our observations of the swarm over the porch roof in some detail. Despite our efforts to follow the males from their resting places on the porch walls we were not able at any time to see them actually join the swarm. They could be seen moving through cracks in the roof some ten to fifteen minutes before the swarm formed. The swarm itself became recognizable with only a dozen mosquitoes participating and quickly increased in size until several thousand individuals took part in it within some five to seven minutes. One medium size swarm was incompletely netted and proved to contain 2,341 males and 3 females. We estimated that the larger swarms at their peak numbered at least 5,000 individuals and occupied a space of six feet in vertical

TABLE 1.—Swarming

Date *August*	*Time* *Start*	*End*	*Light* [1] *Start*	*End*	*Temp.* *Centigrade*
4		8:15			
7	7:28 [2]	8:05 [2]			25°
8	7:48	8:12	9.5	<0.2	22°
10	7:45	8:10	10.	0.4	20°
14	7:40	8:05	20.	0.8	20°

[1] In Weston units.
[2] Probably in error.

Fig. 2.—Close-up of central portion of a large swarm of *A. franciscanus*. (Photo by Graham Heid.)

dimension and three feet in diameter in the middle with somewhat tapered ends. A very characteristic, easily perceived humming is produced by the swarm from its inception and becomes audible from a distance of at least 25 feet at the peak of swarming.

Very complex movements are performed by the individuals within the swarm. They are difficult to follow with the eye in detail, but it appears that movement takes place vertically as well as spirally and that individuals change their position in the swarm. From time to time the entire swarm rises *en masse* for a foot or two and then descends to its original position. The most spectacular feature, that distinguishes this mosquito swarm from other nematocerous swarms observed in this area, is the occurrence of periodic, horizontal (perhaps circular), synchronized sudden rhythmic shifting of individuals back and forth at the peak of swarming. This shifting does not seem to occur at definite intervals but instead sudden rhythmic shifts are concentrated within a short period, usually preceded by one or more vertical movements of the swarm and increased activity. The swarm then loses form almost completely for several seconds, the individuals becoming dispersed and disorganized only to resume the normal swarm-dancing and then build up to the climax again and again. It appears that coupling takes place largely at this time since the majority of paired individuals were seen dropping from the shifting swarm and particularly during the

confused period immediately following it. We were not able to determine whether or not this shifting was initiated by the entrance of females into the swarm.

Once formed the swarm is not easily disturbed, even when part of it was netted, a large percentage of the remaining individuals reformed it. The firing of a flash bulb had no effect on the activity of the swarm, neither did the approach of an individual to within two feet or even less. The remarkable occurrence of swarms in exactly the same location was confirmed by our observations over a period of eleven days. Nothing could be found on the particular spot of the porch roof where the swarms formed that distinguished it to us from the rest of the roof.

The disbanding of the swarm is particularly difficult to follow since the light intensity is very low at this time, but it appears that it takes place gradually and largely within no more than 4 to 5 minutes. Our figures indicate that the entire swarming takes 25 minutes, with most of the activity concentrated in a 15-minute period.

The three large swarms observed over the cottage and the attached stable occurred within 50 feet of each other. The stable roof swarm on several occasions had several foci at the beginning of swarming but usually merged into a single large swarm at the climax. Within 100 feet of the cottage several smaller swarms were observed, one over the roof of a car, and a swarm of some 50 individuals about four feet above the ground and over the railing of the vehicular bridge. The car swarm moved off over the head of an observer and followed him. No mating was observed in any of the smaller swarms.

Comparison of the numbers of resting individuals in the cottage and stable with the numbers in the swarms in their vicinity indicated that only a small fraction took part in these swarms on a given night. Light intensity appears to be one of the principal factors in determining swarming in those individuals that are in the proper state of physiological activity on a given night. As shown in the table, swarming does not occur until light intensity falls below 20 Weston units, and peak activity takes place when it is between 6.5 and 1.6 As Bates (1949) has indicated, swarming in some mosquitoes exhibits a definite diurnal rhythm. We have observed that in *A. franciscanus* no swarming occurs except in the evening even though the stimulus of proper light intensity is present at other times on cloudy days, and within buildings. No observations were made in the morning hours. Temperature did not seem to play a significant part in the activity of the swarm, although a sharp drop in air temperature was noted about 30 minutes before swarming occurred. On two occasions we were doubtful that swarming would take place because of a rather strong northwest wind but it had no effect on the swarms on the roof slopes, which are on the leeward side, and did not even affect the exposed swarm over the top of the cottage.

Coincident with the formation of the swarms, and occasionally preceding it by a few minutes, was the appearance of females of *A. franciscanus* and the beginning of their biting activities. On every occasion the biting increased with the activity of the swarm. We did not determine whether the biting females were those that had recently mated, or were merely attracted to the swarm or to the blood source.

Mating was observed in every swarm over the porch roof. It varied in intensity considerably from day to day. We estimated that on no occasion did more that 500 females mate in a swarm of ten times this number of males. As indicated above coupling occurred at or following the shifting of the swarm. The paired individuals could be easily seen in the swarm and their downward drop followed. Some individuals flew off paired in a horizontal direction. Pairing lasted from a fraction to several seconds. At the height of the swarming as many as fifty pairs could be counted thrashing on the roof. We were surprised to observe fairly

frequently two or even three males apparently coupled with a single female. At the completion of mating the males returned to the swarm while the females flew off.

Blood Feeding. Our first encounter with *A. franciscanus* taking blood from humans was at the site of Imperial Dam on June 10, 1950, when one of us (J.N.B.) was bitten by four females between the hours of 9:20 and 9:30 P.M. Further collecting with the aid of a gasoline lantern in a protected camp area along the Colorado River below the dam disclosed 22 additional females landing during a period of an hour. Because of a strong wind we were not able to continue observations in this area.

The remaining observations and tests were all made at Lee's Lake. As indicated in the section on swarming and mating, females of *A. franciscanus* bit the observers viciously at the time of the swarming. Not uncommonly three or four females attempted to bite at one time. On August 4, 10 females engorged in a 10-minute period and on August 7, 18 engorged females were removed from an observer in 30 minutes with at least an equal number escaping. This biting activity continued after the swarm of males had dispersed.

To determine the extent of the biting activity we made landing records on August 10, 1950, from 8:00 to 9:00 P.M. The results are indicated in Table 2. It will be noted that mosquitoes were also attracted to a duck, a turkey, a rabbit and a guinea pig. The observers worked in pairs and used a flashlight. No mosquitoes were recorded in the area south of the lake (stations 4 and 5). A possible explanation for this is the fact that south of the lake the evening flight had taken place before we entered the area and cattle were available in the adjacent pasture, whereas in the cottage area the observers had been present since 7 P.M. and had attracted the mosquitoes from the beginning of the flight.

Information on blood preference was desirable but as no freshly blooded females could be found in diurnal resting places around the lake it was impossible to carry out precipitin tests. Instead the most obvious areas where blood could be secured were checked within a mile radius of the lake. On July 25 and 28 no mosquitoes could be found. We believe that the full moon at this period may have affected the behavior of the mosquitoes. On August 4, freshly blooded females were found in practically every building or shelter harboring farm animals within a half mile radius of the lake. From two to not more than 200 blooded *A. franciscanus* were found in rabbit and duck cages, in calf and horse stalls and three specimens in a

Table 2.—Landing Records

August 10, 1950

Bait and Station	*Time*				*Total*
	8:00–8:15	*8:15–8:30*	*8:30–8:45*	*8:45–9:00*	
2 men—Sta. 1	7	3	2	2	14
2 men—Sta. 2	3	5	3	1	12
2 men—Sta. 3	0	15	7	3	25
2 men—Sta. 4	0	0	0	0	0
2 men—Sta. 5	0	0	0	0	0
2 men—Sta. 6 with birds	5	4	0	0	9
2 men—Sta. 6 with mammals	6	3	1	0	10
Duck and turkey—Sta. 6	4	5	20	3	32
Rabbit and Guinea Pig—Sta. 6	20	5	9	0	34
TOTAL	45	40	42	9	136

play tent used by children. Since the source of blood appeared obvious in each case no precipitin tests were made.

The very small number of blooded females that were located as compared with the enormous numbers produced in the lake indicated the need for further tests to determine the biting propensities of *A. franciscanus,* particularly since the larger animals in the area were left in the pastures at night. Accordingly on August 14, biting records were made using several different hosts as bait in the clump of trees near the cottage. Two gasoline lanterns provided a light of 0.8 Weston units at the animals arranged in a circle around them. Two observers were assigned to each of the larger animals. The results of the test are indicated in Table 3. Unfortunately the night was cool, 19° C. at 9 P.M., and very few mosquitoes were biting. Nevertheless, the records show that humans are attractive to this species even in competition with the horse and the cow. The protective screen over the lanterns showed at the end of the hour 77 dead *A. franciscanus,* 20 females, and 57 males, indicating that they were present in larger numbers than shown by the biting records.

Females of *A. franciscanus* are very quiet in flight and extremely difficult to spot in the field because of their coloration and sudden, wary approach. They are easily disturbed but are persistent in their attack. They appeared to show a preference to bite humans on the neck, face and arms, but other parts of the body when exposed seemed to be equally attractive. The bite is quite painful to some individuals but to one of us (J.N.B.) it seemed much milder than that of most anophelines. A blood meal is generally secured in one or two minutes, once a favorable spot is located. When undisturbed *A. franciscanus* had a tendency to over-engorge and to pass a droplet of clear fluid from the anus when replete.

Our records show that blood feeding never occurs in this species during the day even when cloudy or in shaded situations where light conditions are favorable. Blood feeding appears to begin in the evening at a time when the light intensity falls below 50 Weston units and continues for at least one and a half hours. We have no definite information as to biting activities during the remaining night hours or morning.

SUMMARY

Observations were made from July 20 to August 16, 1950, on the behavior of males and females of *A. franciscanus* McCracken 1904 in the vicinity of a six-acre artificial lake in the City of Los Angeles, producing an estimated 500,000 adults per day. Various types of shaded situations near the lake provided diurnal resting places for large numbers of males and a smaller number of non-gravid and unblooded females, while very small numbers of blooded females were found resting in farm buildings within a half mile

TABLE 3.—Biting Records

August 14, 1950—Station 6

Bait	*Time*				*Total*
	8:00–8:15	*8:15–8:30*	*8:30–8:45*	*8:45–9:00*	
10 men	1	0	2	1	4
Horse	1	5	4	1	11
Calf	1	2	1	2	6
Sheep	2	0	0	0	2
Rabbit	0	0	0	0	0
Turkey	0	0	0	0	0
TOTAL	5	7	7	4	23

radius. The activities of the adults proved to be entirely crepuscular and were confined to the period when light intensity was below 50 Weston units. Both males and females are moderately attracted to artificial light. There is indirect evidence that adult behavior is markedly influenced by environmental conditions and particularly by strong moonlight. Swarms numbering as many as 5,000 males were observed regularly in the evening when the light intensity fell below 20 Weston units and lasted for 25 minutes. Rather abundant mating was observed at the peak of swarming. Females started feeding on observers shortly before swarm formation and were particularly active in the vicinity of swarms. The limited comparative landing and biting tests indicate that *A. franciscanus* is moderately anthropophilic, feeding in preference on only the larger mammals (horse, cow, sheep), and in fewer numbers on smaller animals (duck, turkey, rabbit, guinea pig). The numbers biting and landing were extremely small in comparison with the enormous populations produced in the lake. Despite the difference in anthropophilism the forms investigated proved morphologically indistinguishable in all stages from *A. franciscanus* from Central and Northern California. Further investigations on this species are indicated in view of its anthropophilism and its great abundance in populated areas in Southern California.

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H. M. SPEECHLEY

Word has been received of the death of H. M. Speechley of Winnipeg on March 15. A more complete account of his life and activities will be made in a forthcoming issue of the *News*. His genial personality was well known to many A.M.C.A. members.

NOTES ON SNIPE FLIES OF THE GENUS *SYMPHOROMYIA* IN ALASKA

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For the past four years the authors and their associates have been observing snipe flies in Pacific coastal Alaska. The most common species, *Symphoromyia atripes* Bigot, is a widely distributed pest in the Territory, and another, *S. kincaidi* Aldrich, likewise a bloodsucker, has been found in the Juneau area. Unfortunately, practically nothing is known of their biologies, apart from the annoying biting habit of the females. It is therefore appropriate to record our data on their Alaskan distribution, abundance, and relation to man for the use of other entomologists.

In his monograph of *Symphoromyia,* Aldrich (1915) designated *S. atripes* the "bad biter *par excellence.*" Several of the 61 females he studied were from Douglas, Alaska. He also cited a single peculiar female snipe fly, in bad condition, from Sheep Creek, Alaska, which he found did not differ greatly from one of his new species, *S. kincaidi* Aldrich, but which he considered "may be a different species." Travis (1949) reported seeing the genus in the more mountainous areas, particularly in the vicinity of Valdez, Alaska.

The junior author has interested himself especially in the practical aspects of the snipe fly problem at Juneau where, during the past three summers, he has made the following observations: The flies occur in moderate numbers in the canyons of mountain torrents, especially Gold and Salmon Creeks at Juneau. They appear on the wing whenever the sun shines from July through mid-September. During the latter part of August they become so abundant as to constitute a serious pest problem, not only on the streams but in the city as well. On fair days hordes may appear, settling clumsily to bite men and animals that pause momentarily. For example, on September 9, 1949, as many as two dozen were counted on the author's dog and an estimated 100 landed on his companion who was baiting a rodent trap. Snipe flies in some years make Evergreen Bowl, city recreation area on Gold Creek, practically useless for an extended time during periods of fine weather in late August or early September. At the same time they invade homes, stores, and hotels, biting unwary babies, guests, and dogs. At the end of several weeks dead snipe flies litter the window ledges of store display fronts like veritable beach windrows. The bite is rather painful. Some workmen laying a pipeline along Gold Creek in 1949, preferred working on rainy days when the snipe fly nuisance was negligible. The flies disappear about the second week in September.

Distribution of *S. atripes.* The collections are from two very different zoogeographical regions: (1) the Kenai Peninsula and Upper Cook Inlet in coastal central Alaska, and (2) southeastern Alaska. Specimens from Valdez have also been identified as *atripes* by specialists of the U. S. National Museum, but we have not seen these. Southeastern Alaskan females differ slightly but consistently from those of the Kenai and Upper Cook Inlet, the stigma being darker and wing infuscation markedly heavier than in the latter. Excepting Homer, Seward, and Juneau, the localities seem to be characterized by small and local *atripes* populations. Material examined came from the following localities: Homer, Seward, Fort Richardson, Hope, Juneau, Deer Mt. (Ketchikan), Ward Lake, Talkeetna Mts. (Palmer), Eklutna Lake, Potter Creek, Eagle River,

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Salmon Creek (Juneau), Greenhouse Creek, and Butte Creek.

Symphoromyia kincaidi Aldrich. The larger size and bright yellow halteres of *kincaidi* females distinguish them from *atripes*. In *atripes* females the halteres are dark brown or black. Under the binocular microscope the abdominal hair of *kincaidi* is mostly yellow or golden; it is black in *atripes*. We have seen only four specimens of *kincaidi*, but it does not appear that the double dark median thoracic stripe of *kincaidi* differs consistently from the many variations of single, double, or 3 stripes with or without indefinite lateral areas of *atripes*. The *Symphoromyia* from Sheep Creek, Alaska, which Aldrich was reluctant to assign to *kincaidi* because his specimen had yellow pile all over, was not encountered. It could be separated easily from our *kincaidi* females which have the jet black hair on front and thorax normal to the species. Material examined came from Juneau on June 1, June 9 and August 28.

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LABORATORY SCREENING OF SOME MOSQUITO LARVICIDES [1]

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I. Introduction

The control of mosquitoes in California with DDT has been very successful since World War II. However, the suspected appearance of resistance to DDT and other insecticides (Bohart, 1950; Deonier, 1950; Smith, 1949) in the last few years presents the necessity for testing newer materials in order to have on hand a replacement should certain resistance makes the ones currently in use no longer effective.

During the summer and fall of 1950 the Bureau of Vector Control, State Department of Public Health, conducted a laboratory screening program at the University of California at Davis. Its main purpose was the testing of various insecticides, both old and new, to determine their value as mosquito larvicides.

Because of its availability the species chosen for these tests was *Culiseta incidens*. The toxicants used were aldrin, lindane, pyrenone, Lethane, DDD, parathion, and other promising insecticides as they were made available.

II. Materials and Methods

The laboratory technique, with some modifications, was adopted from the procedure described by Bohart (1948). Egg rafts of *Culiseta incidens* were collected at Green Valley, Solano County, in a location never subjected to control by insecticides. The rafts were taken from a series of three shallow pools situated within an area of

[1] Conducted under the guidance of Dr. Richard M. Bohart, Assistant Professor of Entomology, University of California at Davis, Davis, California, and in cooperation with the Bureau of Vector Control, California State Department of Public Health.

[2] Employed as Entomologist by the Bureau of Vector Control, California State Department of Public Health, during the period of this work.

approximately 10 yards. Pill boxes lined with damp tissue paper were used to transfer the rafts to the laboratory where they were placed in rearing pans filled with tap water (23° ±1° F.). The larvae were fed daily a mixture of finely ground dog biscuit and yeast. Care was taken to prevent overcrowding, water spoilage and contamination of laboratory equipment by insecticides.

The young fourth stage larvae, used in the toxicity tests, developed in about 15 days. Tests were carried out in one-half pint paper cartons containing 100 cc. of water (105 cc. to compensate for evaporation). Ten larvae were placed in each carton by means of a net-covered wire loop. Food was not provided during the test but this did not appear to affect the well-fed larvae.

Mortalities at 24 and 48 hour readings were recorded. Larvae which were unable to control their movements, that is, to come to the surface, to go to the bottom, or to swim in a normal manner were regarded as mortally affected (Bohart 1949).

The minimum number of tests for each larvicide was regarded to be three. However, in some cases a wide range of results indicates the necessity for more than three tests. At least two replications were made for each dilution and one check for each 100 larvae (one check to ten cartons).

Unless otherwise stated, a one per cent stock solution of each toxicant was prepared. One-half gram of the technical grade insecticide was made up to 50 cc. in xylene containing 5 cc. Triton X-100 (Rohm & Haas Co.). One cc. of the one per cent stock solution was added to 99 cc. of distilled water to give one part in 10,000 by weight (disregarding weight of solvent and emulsifier). One cc. of the latter added to 99 cc. of distilled water yielded one part in one million which was used as the stock solution for further dilutions.

Standard emulsions were used in preference to other stock solutions because it is believed that the use of an emulsion more closely parallels the field application of larvicides. Preliminary tests with DDT emulsions and DDT acetone suspensions failed to show any significant differences in toxicity.

Used pipettes and flasks were flushed several times in tap water and subsequently washed in acetone. With the exception of those containing controls, all cartons were discarded at the end of each trial.

III. EXPERIMENTS AND DISCUSSION

Table I summarizes the approximate LD50 and LD90 of the larvicides used on the young fourth stage *Culiseta incidens* larvae. The comparative per cent mortality in dilutions from 1–1 million to 1–400 million (one part by weight in distilled water, disregarding weight of solvent and emulsifier) are shown in Table II.

Based on the approximate median lethal dose Velsicol heptachlor [1] (Velsicol AR-50, Altox 1045 A-2), aldrin [2], parathion [3], heptachlor [4] (with xylene-Triton X-100), and DDT with Lethane-384 [5] used as a solvent are, respectively, 8.6, 8.4, 5.5, 2.8, and 2.2 times as toxic as DDT.

Tests with Velsicol heptachlor (42 per cent emulsifiable concentrate) have shown it to possess a high larvicidal activity with an approximate LD50 of 1–155 million. Technical Velsicol heptachlor with xylene-Triton X-100 (LD50—1–50 million) was only one-third as effective as the emulsifiable concentrate, but 2.8 times as toxic as DDT.

Aldrin with an LD50 of 1–150 million has about the same larval toxicity as heptachlor (emulsifiable concentrate), while an LD50 of 1–18 million ranks dieldrin with DDT.

Parathion (96–98 per cent pure aryl alkyl thiono phosphate) ranked third in its toxicity to *Culiseta incidens* larvae with an LD50 of 1–100. The two additional

[1] Velsicol Corp., Chicago, Illinois.
[2] Julius Hyman & Co., Denver, Colorado.
[3] American Cyanimid, New York, N. Y.
[4] Velsicol Corp.
[5] Rohm and Haas Co., Philadelphia, Pennsylvania.

organic phosphates tested, Compound 4041 [1], and o-o-di-isopropyl nitrophenyl thiophosphate [1] proved to be ineffective at dilutions of 1–10 million and above.

During the summer of 1950 large quantities of Navy surplus Lethane Mosquito Insecticide No. 1 were turned over to the various California Mosquito Abatement Districts. This insecticide is registered with the Bureau of Chemistry, State Department of Agriculture, as beta butoxy betá thiocyano diethyl ether (6 per cent by weight) and deodorized kerosene (94 per cent by weight).

It has been suggested [2] from field activities that an addition of Lethane to a solution of DDT might fortify a larvicidal solution by adding pupicidal qualities to it. Used as a larvicide, one part of DDT to one part of Lethane [3] and one part of DDT to one-third part of Lethane did not show any advantages over DDT alone.

A one per cent Lethane xylene-Triton X-100 emulsion resulted in a 100 per cent larval mortality at 1–100,000; 50 per cent mortality at 1–500,000; and no mortality at 1–1 million. A 100 per cent mortality at 1–100,000 and no mortality at 1–500,000 was obtained in tests using xylene-Triton X-100 alone. This would seem to indicate that as a larvicide Lethane Mosquito Insecticide No. 1 emulsion contributes little to the toxicity of DDT.

Tests using DDT with Lethane-384 [4] (active ingredients—beta butoxy betá thiocyano diethyl ether 50 per cent by volume and petroleum distillate 50 per cent by volume) as a solvent proved to be 2.2 times as toxic as DDT used alone.

Toxaphene,[5] lindane,[6] Q137 [4] and DDD [4] were below DDT in toxicity with LD50's of 1–7, 1–4.5, 1–3.5, and 1–2, respectively.

Synthetic Cinerin 1 [7] was ineffective at dilutions of 1–1 million and above.

Sample HE-761 [4] was received from Rohm & Haas Company and labeled as technical 3-4-dichloro-benzene sulfo-nitranilide-4 (approximately 95 per cent purity) with the additional statement that it was for use on rice field mosquitoes only. Since *Anopheles* sp. were not available, *Culiseta incidens* larvae were substituted. A one per cent HE-761 acetone solution was ineffective against *Culiseta incidens* at dilutions of 1–1 million and above.

It was originally planned to test the larvicides at dilutions from 1–10 million through 1–400 million; discarding those which produced no mortality at the lowest dilution. Many larvicides which would have been discarded under the original plan were encountered as the experiments progressed. Hence, it was decided to check mortalities at dilutions from 1–1 million to 1–10 million on the theory that a toxicant having an LD50 in that range may be of some value in the field depending upon its availability, expense of application, and toxicity to man, domesticated animals and wild life.

Results are not complete on Maclean's chlordane,[8] Compound 4041, o-o-di-isopropyl nitro phenyl thiophosphate, CS674A [9] and CS645A in dilutions below one part in 10 million.

Considerable variability was encountered in tests with pupae. At present only the general statement can be made that DDT, DDT-Lethane Mosquito Insecticide No. 1 (1–1), DDT with Lethane-384 used as a solvent, Velsicol heptachlor, heptachlor with xylene-Triton X-100, aldrin, lindane, toxaphene, DDD, Q137, Compound 4041 and parathion show no effect at dilutions above 1–5 million.

Summary

1. Laboratory tests were made with promising insecticide emulsions in an

[1] American Cyanimid.
[2] Dr. Isenhour (Rohm and Haas Co., San Francisco).
[3] Lethane Mosquito Insecticide No. 1.
[4] Rohm and Haas.
[5] Hercules Powder Co., Inc., Wilmington, Delaware.
[6] California Spray Chemical Corp., Richmond, California.
[7] U. S. Industrial Chemicals, New York, N. Y.
[8] Macleans Corp., San Francisco, California.
[9] Commercial Solvents Corp., New York, N. Y.

TABLE I.—LD50 and LD90 of larvicide emulsions used against young fourth stage *Culiseta incidens* Thomson; water temperatures 23°±1° F.; length of test period 48 hours.

Larvicide	*No. of Tests*	*Approx. LD50*	*Approx. LD90*	*Remarks*
1. Velsicol heptachlor	5	1–155	1–35	
2. Aldrin (118)	3	1–150	1–45	
3. Parathion	4	1–100	1–80	
4. Heptachlor	4	1–50	1–25	
5. DDT with Lethane-384 used as a solvent	4	1–40	1–15	Larvicides 5, 6, 7, 9, and 10 contain the same amount of DDT.
6. DDT-Lethane (1–1/3)	3	1–25	1–10	
7. DDT-Lethane (1–1)	5	1–20	1–8	
8. Dieldrin (497)	4	1–18	1–8	
9. DDT	14	1–18	1–7	
10. DDT-Acetone	4	1–15	1–7	
11. Toxaphene	3	1–7	1–3.5	
12. Lindane	3	1–4.5	1–2.5	
13. Q137	3	1–3.5	1–1.5	
14. DDD	3	1–2	1–.2	
15. CS674A	3	1,1-bis(p-chlorophenyl) 2-nitro butane		No effect at dilutions above 1–10 million.
16. CS645A	3	1,1-bis(p-chlorophenyl) 2-nitro propane		No effect at dilutions above 1–10 million.
17. Compound 4041	3	Results of dilutions below 1–10 millions based on 1 test only		No effect at dilutions above 1–10 million.
18. o-o-di-isopropyl-nitro-phenyl thiophosphate	3	Tests not conclusive at dilutions below 1–10 million		No effect at dilutions of 1–10 million and above.
19. Maclean's chlordane	2			No effect at dilutions of 1–10 million and above.
20. Synthetic Cinerin I	2			No effect at dilutions of 1–1 million and above.
21. HE761-Acetone	2			No effect at dilutions of 1–1 million and above.
22. 1% Lethane	2	1–500,000	1–90,000	No effect at dilutions of 1–1 million and above.
23. Xylene-Triton X-100	2			1–100,000, 100% mortality, 1,500,000, no mortality.
24. Checks				1.4% mortality, 780 larvae used.

Table II.—Toxicity of larvicide emulsions to young fourth stage *Culiseta incidens* (Thomson); water temperature 24°-31° F.; length of test 48 hours.

Larvicide	No. of Tests	Average Per Cent Mortality								
		1–400 million	1–200 million	1–100 million	1–50 million	1–30 million	1–20 million	1–10 million	1–5 million	1–2.5 million	1–1 million
Velsicol heptachlor	5	10	40.4	63	81	92	100	100			
Aldrin (118)	3	0	27.7	85.6	87.6	100	100	100			
Parathion	4	0	23.6	51.8	94.6	100	100	100			
Heptachlor	4		0	9.7	50.3	88.3	98.7	100			
DDT with Lethane used as a solvent	4			0	29.2	69.7	85	97.5	100		
DDT-Lethane (1–1/4)	3				0	40.7	59.3	90.5	100		
DDT-Lethane (1–1*)	5				0	28	50.8	82	100		
Dieldrin (497)	4				0	21.6	41.2	84.7	100		
DDT	14				0	10.4	40.1	70.8	100		
DDT-Acetone	4						27.2	66.6	100		
Toxaphene	3							15	71.9	100	100
Endrin	3							0	38	90	100
Q137	3							0	13	69.7	100
DDD	3							0	5	38	95

*One part by weight in distilled water.

attempt to evaluate their comparative toxicity to mosquito larvae.

2. *Culiseta incidens* was used exclusively due to its availability, vigor and high survival under laboratory conditions.

3. Table I presents the approximate LD_{50} and LD_{90} of the larvicide emulsions used against young fourth stage *Culiseta incidens* larvae.

4. The comparative per cent mortalities in dilutions from 1–1 million to 1–400 million (one part by weight in distilled water) are shown in Table II.

5. Based on the approximate median lethal dose, Velsicol heptachlor (Velsicol AR-40, Altox 1045A-2), aldrin, parathion, heptachlor (with xylene-Triton X-100), and DDT with Lethane 384 used as solvent are, respectively 8.6, 8.4, 5.5, 2.8, and 2.2 times as toxic as DDT.

6. One part of DDT to one part of Lethane [1] and one part of DDT to one-third part of Lethane do not show any advantages over DDT used by itself.

7. More tests are indicated for CS674A, CS645A, o-o-di-isopropyl nitrophenyl thiophosphate and other larvicides showing no kill at dilutions above 1–10 million.

8. Considerable variation appeared in tests with pupae. More tests are needed before definite results can be submitted. At present only the general statement can be made that DDT, DDT-Lethane (1–1), DDT with Lethane used as a solvent, Velsicol heptachlor, heptachlor (with xylene-Triton X-100), aldrin, lindane, toxaphene, DDD, Q137, Compound 4041, and parathion show no effect on pupae at dilutions above 1–5 million.

9. Other species of mosquitoes may present different reactions to the foregoing larvicides.[2] However, it is felt that tests with *Culiseta incidens* exclusively, give a general picture of comparative toxicities.

[1] Lethane Mosquito Insecticide No. 1.

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[2] For example, DDD has been reported by Bohart (1949) as considerably more toxic than DDT to *Aedes dorsalis* and *Aedes squamiger*.

MOSQUITO DIARY: OBSERVATIONS ON MOSQUITO CONTROL FOR TREE-MEN AND PEST-CONTROL OPERATORS

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Since the advent of DDT, many tree-workers have had mosquito control forced upon them because in many localities they and they alone had equipment such as hydraulic sprayers and mist-blowers which could be adapted to this work. Unfortunately, there was very little information among these workers on the subject of mosquito biology or on mosquitoes in general, and, with too blind a trust in DDT, they ran afoul of many snags and pitfalls which might have been avoided had they been trained entomologists.

The following is a brief review of attempts at mosquito control in Stamford, Connecticut, written roughly in the form of a diary with notations and tentative conclusions based on field observations, largely the work of tree men.

October 1, 1947. For two seasons now, we have obtained excellent results in controlling *Anopheles quadrimaculatus, A. punctipennis,* and *Culex pipiens* by spraying the buildings on the grounds of the Bartlett Tree Research Laboratories inside and out, particularly screens, doorways, basements and sheds, with DDT solution (10 per cent) (Xylene and kerosene) by means of a Harco hand sprayer, compressed air knapsack sprayer or stirrup pump.

Results on the woodland and meadow mosquitoes, *Aedes canadensis, A. fitchii, A. vexans, A. excrucians* and *Mansonia perturbans* have been negative both where the mist blower at the rate of one pound of actual DDT per acre and the hydraulic sprayer where DDT wettable powder at one pound of actual DDT per gallon were used. Both types of application promoted red spider increase on trees and shrubbery and each caused foliage injury, evidently from the oil or solvents used in preparing the DDT.

The Town of Stamford has purchased a mist blower and they plan to use DDT extensively by this means for mosquito control.

July 1, 1948. An excellent demonstration of rotenone-pyrethrum resin emulsion for mosquito control was given in late June. The day before a wedding and again that morning, the grounds were treated by a mist blower using this emulsion at the rate of one part to sixteen of water. There were over 200 guests at the wedding reception and not a mosquito attended. Many remarked on the complete freedom from mosquitoes and flies. Using myself as bait, I spent a short while in the garden and in the lawn area each day. Twelve days later there were still no mosquitoes. The first one seen and felt was an *Aedes vexans* which was collected in the garden 17 days after the treatment. Pyrethrum-rotenone has a great advantage over DDT for this purpose, as in addition to controlling mosquitoes and flies it also kills red spiders and aphis, and leaves no objectionable residue, as well as being safe on evergreens, flowers and tender plants. The results of this application were really surprising and doubtless suggest a particular condition inasmuch as pyrethrum-rotenone sprays have no lasting residual effect.

October 1, 1948. All season long in Stamford the roar of the municipal mist blower has been heard, night and day. The results, however, were far from satisfactory so far as mosquitoes were concerned. Elm, maple and linden foliage was sickly yellow either from oil injury or from red spiders, aphids, lacebugs or other pests fostered by the DDT.

On the evening of September 2 I attended an open air meeting in Cortland

Park and was mosquito-bitten to an extent not experienced in years.

February 1, 1949. *Power Sprayers.* Hydraulic spraying with wettable DDT powder is a satisfactory method of applying the insecticide around buildings close to the ground, in corners, near walks, etc., where the mosquitoes are. Do not spray foliage of trees or shrubbery, or damage from spray injury or red spiders may result. Keep the spray out of water, both running and standing, where fish or other animals might be poisoned.

August 1, 1949. Mosquitoes have been unusually abundant this summer not in spite of, but because of the drought. *Aedes vexans* and *A. excrucians* were most common in collections at Stamford. What happened appears to be that the puddles and pools in the meadows, swamps and woodlands having all dried up, the mosquitoes went to human habitations in search of water. Very good control was obtained by spraying the foundations and screens with DDT by hand sprayer, taking care that none of the spray got on the plants or shrubbery around the house. Then the plants and shrubbery were sprayed by power sprayer with a pyrethrum-rotenone emulsion. This ended the mosquito nuisance in that particular place.

September 1, 1949. The City of Stamford did several thousand dollars worth of mist-blowing for mosquito control this past season, resulting in considerable foliage injury on trees and shrubs along the "blast-line" (10 or 15 feet up and down nearest the nozzle of the blower). This injury has been most pronounced on flowering dogwood, azaleas, red maple, birch and oak.

The results in mosquito control have been variable. Mosquitoes were extremely abundant and troublesome in Stamford during the drought of June and July, 1949. Since the coming of the rains, however, the nuisance has decidedly abated. In late July I inquired about the mosquito situation from various parties in North Stamford and the surrounding areas. Mosquitoes had been very troublesome at two places on Chestnut Hill Road, one of which had been mist-blown four times this spring. At the other place no DDT had been used and the mosquitoes were just as bad. Two places at Scofieldtown Road were troubled, two places on Sunset Road, one on Skymeadow Drive, two on Wire Mill Road, while on High Ridge Road two opinions were expressed. One party stated that he had never seen mosquitoes so bad as they were this summer while another who lived about a mile away claimed that he had not seen any mosquitoes at all. The latter place had not been mist-blown. Another report of mosquito abundance came from Ansonia, Conn. I was unable to find out whether or not the latter was in mist-blown territory. These conflicting opinions indicate that it is unwise to draw conclusions without more specific data. In other words, generalizations from a few observations are dangerous.

In spite of the recently demonstrated ability of some mosquitoes to develop resistance to DDT, the so-called "domestic" mosquitoes, including the malaria mosquito, *Anopheles quadrimaculatus* (Say) and the house mosquitoes, *Culex pipiens* L., *Culex territans* Walker and also *Anopheles punctipennis* (Say) have been controlled to a remarkable degree, at least until now, by properly timed, properly applied, sufficiently large dosages of DDT used in and around buildings, on screens, foundations, and the like.

A word or two on the history of malaria in North Stamford. The last epidemic was during World War I, but before the turn of the century malaria or "ague fever" as it was then called, was common in this area. What caused malaria to disappear here? Certainly not the disappearance of *anopheles* because there are still many malarial mosquitoes around, but rather the fact that malarial patients were segregated under mosquito bars and cured before the mosquitoes could bite them and transfer the disease to other people.

My recommendations for tree men and other persons not primarily engaged professionally in mosquito control are as follows:

1. *For residual work:* Spray screens, doorways, shady corners, sheds and foundations of buildings. If lawns or areas around buildings are sprayed, keep the spray as low as possible—close to the ground.

Do *not* spray large bodies of water, except with amounts that will not harm desirable fauna. Spraying of water on a large scale should be done only by experienced mosquito control men.

2. Do *not* spray vegetable or flower gardens, fruit trees, ornamentals or evergreens.

3. Do *not* try to treat large swamps, meadows or woods. Confine your efforts to structures like buildings, arenas, bandstands, grandstands and the like, and their immediate environs.

4. Except during an outbreak of cankerworm or gypsy or other caterpillars, do not spray any trees but elms.

5. Do not spray pastures or areas where animals are grazing or feeding.

6. Do not spray food products.

For general mosquito spraying on estates, the following method has proved most satisfactory.

1. Apply DDT to bases of buildings, screens, corners, outbuildings (inside and out) taking care that oil sprays do not get on vegetation, and that no spray falls on drinking water or fishponds or into food. This gives a residual effect of several days or more.

2. Apply rotenone-pyrethrum emulsion either by hydraulic power sprayer or mistblower to lawns, shrubbery, and ground around the buildings. The effects are transient and should be timed to control a large flight of mosquitoes, or before a lawn party or outdoor meeting.

DISTRIBUTION RECORDS OF WEST TEXAS MOSQUITOES

R. B. EADS,[1] G. C. MENZIES,[1] AND L. J. OGDEN[2]

Although extensive mosquito surveys have been made in Texas in connection with disease vector control programs, population concentrations have made it necessary to expend a majority of the effort in the eastern half of the state. Mosquito distribution records, obtained as a result of these surveys, have been the subject of several reports, e.g., McGregor and Eads (1943) and O'Neill, Ogden, and Eyles (1944).

In an effort to overcome the dearth of information relative to species distribution in west Texas, New Jersey light traps were operated in about fifty counties located in roughly the western half of the state in 1945 and 1946.

Male terminalia slides were studied whenever any doubt as to the specific status of a mosquito existed and are retained in the collection of the Texas State Department of Health.

Miss Kellie O'Neill, Miss Frances Willard, Mr. N. M. Randolph and Mr. T. McGregor, formerly associated with the Texas State Department of Health, have made valuable taxonomic contributions to this work. The widespread operation of the light traps was made possible by the excellent liaison work of the late Mr. Alvah Otting with local public officials.

The 40 species of mosquitoes included in the present series of records are as follows:

[1] Bureau of Laboratories, Texas State Department of Health, Austin.

[2] Communicable Disease Center, Public Health Service, Federal Security Agency, Atlanta, Georgia.

Aedes aegypti Linnaeus, *A. alleni* Turner, *A. atropalpus* (Coquillett), *A. canadensis* (Theobald). *A. dorsalis* (Meigen), *A. nigromaculis* (Ludlow), *A. taeniorhynchus* (Wiedemann), *A thelcter* Dyar, *A. triseriatus* (Say), *A. vexans* (Meigen).

Anopheles crucians Wiedemann, *A. pseudopunctipennis* Theobald, *A. punctipennis* (Say), *A. quadrimaculatus* Say.

Culex abominator Dyar and Knab, *C. coronator* Dyar and Knab, *C. erraticus* (Dyar and Knab), *C. nigripalpus* Theobald, *C. quinquefasciatus* Say, *C. restuans* Theobald, *C. salinarius* Coquillett, *C. stigmatosoma* Dyar, *C. tarsalis* Dyar, *C. territans* Walker.

Culiseta incidens (Thomson), *C. inornata* (Williston).

Deinocerites spanius (Dyar and Knab).

Mansonia perturbans (Walker), *M. titillans* (Walker).

Orthopodomyia signifera (Coquillett).

Psorophora ciliata (Fabricius), *P. confinnis* (Lynch Arribalzaga), *P. cyanescens* (Coquillett), *P. discolor* (Coquillett), *P. ferox* (Humboldt), *P. signipennis* (Coquillett).

Toxorhynchites rutilis septentrionalis (Dyar and Knab).

Uranotaenia lowii Theobald, *U. sapphirina* (Osten Sacken), *U. syntheta* Dyar and Shannon.

Bailey County — Trap operated May–September 1945. Total mosquitoes taken —310. *Aedes vexans*—1, *Culex quinquefasciatus*—142, *C. tarsalis*—160, *Culiseta inornata*—1, and *Psorophora signipennis* —1. Damaged specimens not specifically determined—5.

Baylor County — Trap operated March–November 1945, and April–June 1946. Total mosquitoes taken — 916. *Aedes alleni*—1, *A. dorsalis*—1, *A. nigromaculis*—264, *A. thelcter*—6, *A. vexans*—6, *Anopheles pseudopunctipennis*—6, *A. punctipennis*—3, *Culex erraticus*—18, *C. quinquefasciatus*—32, *C. restuans*—3, *C. tarsalis* —203, *Culiseta inornata*—43, *Orthopodomyia signifera*—2, *Psorophora ciliata*—6, *P. confinnis*—3, *P. cyanescens*—21, *P. discolor*—4, *P. signipennis*—213, *Uranotaenia lowii*—1, and *U. syntheta*—3. Damaged specimens not specifically determined—77.

Brewster County — Trap operated June–November 1945, and May–September 1946. Total mosquitoes taken—593. *Aedes dorsalis*—10, *A. vexans*—2, *Anopheles pseudopunctipennis*—96, *Culex erraticus*—2, *C. quinquefasciatus*—99, *C. stigmatosoma*—2, *C. tarsalis*—142, *Culiseta inornata*—3, *Psorophora confinnis*—7, *P. cyanescens*—3, *P. discolor*—17, *P. signipennis*—181, and *Uranotaenia syntheta*—1. Damaged specimens not specifically determined—28.

Childress County — Trap operated October 1945, and May, June–October 1946. Total mosquitoes taken—54. *Aedes alleni*—1, *Anopheles punctipennis*—2, *A. quadrimaculatus*—1, *Culex erraticus*—7, *C. quinquefasciatus*—9, *C. tarsalis*—22, *Psorophora discolor*—2, and *P. signipennis*—10.

Coleman County — Trap operated February, April–October 1946. Total mosquitoes taken—474. *Aedes alleni*—1, *A. atropalpus*—4, *A. nigromaculis*—2, *A. triseriatus*—1, *A. vexans*—1, *Anopheles pseudopunctipennis*—37, *A. punctipennis* —40, *Culex abominator*—9, *C. erraticus*— 66, *C. quinquefasciatus*—77, *C. stigmatosoma*—3, *C. tarsalis*—212, *Culiseta inornata* —21, *Orthopodomyia signifera*—1, *Psorophora ciliata*—1, *P. confinnis*—9, *P. cyanescens*—3, *P. discolor*—4, *P. signipennis*—32, and *Uranotaenia sapphirina*—1. Damaged specimens not specifically determined—40.

Culberson County — Trap operated July–October 1945, and April–July 1946. Total mosquitoes taken—387. *Aedes dorsalis*—14, *A. nigromaculis*—6, *Anopheles pseudopunctipennis*—6, *Culex quinquefasciatus*—56, *C. tarsalis*—178, *Culiseta inornata*—1, *Psorophora confinnis*—10, *P. discolor*—6, and *P. signipennis*—84. Damaged specimens not specifically determined—26.

Dickens County — Trap operated May–November 1945, and April–June 1946. Total mosquitoes taken—974. *Aedes dorsalis*—7, *A. nigromaculis*—50, *A. thelcter*—2, *A. vexans*—4, *Anopheles pseudo-*

punctipennis—3, *Culex erraticus*—9, *C. quinquefasciatus*—30, *C. tarsalis*—728, *Culiseta inornata*—4, *Psorophora ciliata*—10, *P. confinnis*—7, *P. cyanescens*—18, *P. discolor*—7, and *P. signipennis*—80. Damaged specimens not specifically determined—15.

Dimmit County—Trap operated May–October 1946. Total mosquitoes—2,169. *Aedes nigromaculis*—10, *A. thelcter*—4, *A. vexans*—9, *Anopheles pseudopunctipennis*—19, *A. punctipennis*—1, *A. quadrimaculatus*—5, *Culex coronator*—1, *C. erraticus*—56, *C. quinquefasciatus*—232, *C. tarsalis*—151, *Psorophora ciliata*—65, *P. confinnis*—145, *P. cyanescens*—246, *P. discolor*—90, *P. signipennis*—1,118, *Uranotaenia lowii*—5, *U. sapphirina*—2, and *U. syntheta*—10.

Edwards County—Trap operated June–October 1945. Total mosquitoes—3,274. *Aedes atropalpus*—1, *A. vexans*—1, *Anopheles pseudopunctipennis*—1, *A. punctipennis*—1, *Culex erraticus*—1, *C. stigmatosoma*—1, *C. quinquefasciatus*—3,140, *C. tarsalis*—27, *Culiseta inornata*—1, *Orthopodomyia signifera*—2, and *Psorophora signipennis*—3. Damaged specimens not specifically determined—95.

Erath County—Trap operated May–October 1945. Total mosquitoes—1,133. *Aedes aegypti*—3, *A. nigromaculis*—132, *A. vexans*—15, *Anopheles pseudopunctipennis*—3, *A. punctipennis*—7, *A. quadrimaculatus*—2, *Culex erraticus*—45, *C. quinquefasciatus*—42, *C. restuans*—4, *C. salinarius*—21, *C. tarsalis*—185, *Culiseta inornata*—12, *Psorophora ciliata*—5, *P. confinnis*—34, *P. cyanescens*—5, *P. discolor*—24, and *P. signipennis*—391. Damaged specimens not specifically determined—203.

Frio County—Trap operated April–October 1946. Total mosquitoes taken—1,677. *Aedes nigromaculis*—3, *A. thelcter*—53, *A. triseriatus*—1, *Anopheles crucians*—2, *A. pseudopunctipennis*—4, *A. punctipennis*—2, *Culex erraticus*—16, *C. quinquefasciatus*—1, *C. tarsalis*—79, *Mansonia titillans*—1, *Psorophora ciliata*—136, *P. confinnis*—49, *P. cyanescens*—577, *P. discolor*—257, *P. signipennis*—485, *Uranotaenia lowii*—2, and *U. syntheta*—9.

Gaines County—Trap operated June–November 1945, and June 1946. Total mosquitoes taken—176. *Aedes dorsalis*—7, *A. nigromaculis*—2, *Anopheles pseudopunctipennis*—3, *Culex tarsalis*—91, *C. quinquefasciatus*—57, *Culiseta inornata*—6, *Psorophora ciliata*—2, *P. signipennis*—5, and *Uranotaenia syntheta*—1. Damaged specimens not specifically determined—2.

Hale County—Trap operated May–October 1945, and April–July 1946. Total mosquitoes taken—4,782. *Aedes dorsalis*—1, *A. nigromaculis*—486, *A. vexans*—1, *Anopheles pseudopunctipennis*—6, *A. punctipennis*—1, *Culex quinquefasciatus*—11, *C. tarsalis*—3,291, *Culiseta inornata*—18, *Psorophora ciliata*—17, *P. cyanescens*—9, *P. discolor*—5, *P. signipennis*—910, and *Uranotaenia syntheta*—1. Damaged specimens not specifically determined—25.

Hansford County—Trap operated March–July 1946. Total mosquitoes taken—45. *Aedes dorsalis*—9, *A. vexans*—1, *Culex tarsalis*—29, *Culiseta incidens*—2, *Psorophora confinnis*—2, and *P. signipennis*—2.

Howard County—Trap operated May–July 1945, and April–September 1946. Total mosquitoes taken—394. *Aedes nigromaculis*—1, *A. thelcter*—9, *Anopheles pseudopunctipennis*—50, *Culex erraticus*—12, *C. quinquefasciatus*—37, *C. tarsalis*—108, *Culiseta inornata*—7, *Psorophora ciliata*—3, *P. confinnis*—10, *P. cyanescens*—4, *P. discolor*—1, *P. signipennis*—148, and *Uranotaenia syntheta*—4.

Hudspeth County—Trap operated July–August and September 1945, and April–June 1946. Total mosquitoes taken—465. *Aedes dorsalis*—37, *A. vexans*—12, *Anopheles pseudopunctipennis*—19, *A. punctipennis*—2, *Culex salinarius*—1, *C. tarsalis*—131, *Culiseta inornata*—5, *Psorophora confinnis*—28, and *P. signipennis*—2. Damaged specimens not specifically determined—228.

Hutchinson County—Trap operated

July–August and September 1945, and April–June 1946. Total mosquitoes taken —163. *Aedes nigromaculis*—3, *A. vexans* —6, *Culex quinquefasciatus*—62, *C. tarsalis*—85, *Psorophora cyanescens*—2, and *P. signipennis*—5.

Jim Wells County — Trap operated April–October 1946. Total mosquitoes taken—1,567. *Aedes nigromaculis*—10, *A. taeniorhynchus*—195, *A. thelcter*—250, *Anopheles crucians*—19, *A. pseudopunctipennis*—8, *A. quadrimaculatus*—3, *Culex erraticus*—164, *C. quinquefasciatus*—273, *C. stigmatosoma*—6, *C. tarsalis*—53, *Mansonia titillans*—4, *Psorophora ciliata*—8, *P. confinnis*—99, *P. cyanescens*—333, *P. discolor*—66, *P. signipennis*—31, and *Uranotaenia lowii*—45.

Jones County — Trap operated April 1945, and April–September 1946. Total mosquitoes taken—220. *Aedes nigromaculis*—45, *A. vexans*—1, *Anopheles punctipennis*—2, *Culex quinquefasciatus* —64, *C. tarsalis*—60, *Culiseta inornata*—1, *Psorophora ciliata*—1, *P. cyanescens*—1, *P. discolor*—7, and *P. signipennis*—38.

Kerr County — Trap operated June–November 1945, and April–September 1946. Total mosquitoes taken—254. *Aedes alleni*—1, *A. vexans*—1, *Anopheles pseudopunctipennis*—12, *A. punctipennis* —11, *Culex erraticus*—11, *C. quinquefasciatus*—163, *C. stigmatosoma*—21, *C. tarsalis*—22, *Culiseta inornata*—3, *Orthopodomyia signifera*—2, and *Psorophora signipennis*—7.

Kimble County — Trap operated June–November 1945, and February–September 1946. Total mosquitoes taken—1,959. *Aedes aegypti*—3, *A. alleni*—1, *A. dorsalis*—2, *A. nigromaculis*—3, *A. triseriatus*—19, *A. vexans*—337, *Anopheles pseudopunctipennis*—47, *A. punctipennis* —128, *Culex abominator*—9, *C. erraticus* —137, *C. nigripalpus*—1, *C. quinquefasciatus*—714, *C. salinarius*—5, *C. stigmatosoma*—112, *C. tarsalis*—86, *C. territans* —2, *Culiseta inornata*—109, *Orthopodomyia signifera*—4, *Psorophora ciliata*—37, *P. confinnis*—1, *P. cyanescens*—60, *P. discolor*—10, *P. ferox*—1, *P. signipennis*—75, *Uranotaenia lowii*—3, *U. sapphirina*—3, and *U. syntheta*—6. Damaged specimens not specifically determined—44.

Kleberg County — Trap operated April–September 1946. Total mosquitoes taken—349. *Aedes sollicitans*—6, *A. taeniorhynchus*—2, *A. thelcter*—40, *Anopheles pseudopunctipennis*—4, *A. quadrimaculatus*—1, *Culex erraticus*—65, *C. tarsalis* —3, *Deinocerites spanius*—4, *Mansonia titillans*—1, *Psorophora ciliata*—7, *P. confinnis*—108, *P. cyanescens*—73, *P. discolor* —14, *P. signipennis*—11, and *Uranotaenia lowii*—10.

Live Oak County — Trap operated April–August 1946. Total mosquitoes taken—266. *Anopheles crucians*—1, *A. punctipennis*—1, *A. quadrimaculatus*—1, *Culex erraticus*—19, *C. quinquefasciatus* —9, *C. tarsalis*—4, *Psorophora ciliata*—5, *P. confinnis*—147, *P. cyanescens*—45, and *P. signipennis*—34.

Lubbock County — Trap operated May–June 1945, and May–October 1946. Total mosquitoes taken—332. *Aedes dorsalis*—4, *A. nigromaculis*—4, *Anopheles pseudopunctipennis*—16, *Culex quinquefasciatus*—4, *C. restuans*—1, *C. tarsalis*— 292, *Psorophora confinnis*—1, and *P. signipennis*—10.

Mason County—Trap operated June–October 1945, and April–July 1946. Total mosquitoes taken—305. *Aedes aegypti* —1, *A. vexans*—1, *Anopheles pseudopunctipennis*—3, *A. punctipennis*—19, *Culex abominator*—1, *C. erraticus*—31, *C. quinquefasciatus*—61, *C. stigmatosoma*— 25, *C. tarsalis*—79, *Culiseta inornata*—22, *Psorophora cyanescens*—1, *P. signipennis* —41, and *Uranotaenia syntheta*—1. Damaged specimens not specifically determined —19.

Maverick County — Trap operated June–November 1945, and February and April–September 1946. Total mosquitoes taken—1,384. *Aedes nigromaculis*—2, *A. vexans*—85, *A. thelcter*—228, *Anopheles pseudopunctipennis*—9, *Culex abominator* —1, *C. erraticus*—40, *C. quinquefasciatus* —187, *C. tarsalis*—70, *Culiseta inornata* —3, *Psorophora ciliata*—2, *P. confinnis*—

67, *P. discolor*—17, *P. cyanescens*—49, and *P. signipennis*—624. Damaged specimens not specifically determined—10.

McCulloch County — Trap operated June–August and November 1945 and April–June 1946. Total mosquitoes taken—82. *Aedes vexans*—2, *Anopheles punctipennis*—2, *Culex erraticus*—13, *C. quinquefasciatus*—13, *C. salinarius*—1, *C. stigmatosoma*—1, *C. tarsalis*—13, *Culiseta inornata*—12, *Psorophora cyanescens*—3, and *P. signipennis*—18. Damaged specimens not specifically determined—4.

Midland County — Trap operated June–August 1945, and March–June and August 1946. Total mosquitoes taken—965. *Aedes dorsalis*—348, *A. nigromaculis*—37, *Anopheles pseudopunctipennis*—5, *Culex quinquefasciatus*—19, *C. tarsalis*—503, *Psorophora confinnis*—2, *P. signipennis*—48, and *Uranotaenia syntheta*—3.

Nolan County — Trap operated June–November 1945, and May–June 1946. Total mosquitoes taken—177. *Aedes vexans*—7, *A. nigromaculis*—1, *A. thelcter*—1, *Anopheles pseudopunctipennis*—1, *A. punctipennis*—2, *A. quadrimaculatus*—1, *Culex erraticus*—4, *C. quinquefasciatus*—11, *C. salinarius*—1, *C. tarsalis*—35, *Culiseta inornata*—1, *Psorophora ciliata*—7, *P. confinnis*—6, *P. cyanescens*—9, *P. discolor*—1, *P. signipennis*—74, and *Uranotaenia syntheta*—1. Damaged specimens not specifically determined—14.

Ochiltree County — Trap operated May and June 1945, and August and September 1946. Total mosquitoes taken—1,503. *Aedes dorsalis*—1,002, *A. nigromaculis*—42, *A. vexans*—27, *Culex quinquefasciatus*—25, *C. tarsalis*—369, *Culiseta inornata*—2, *Psorophora confinnis*—1, and *P. signipennis*—13. Damaged specimens not specifically determined—22.

Pecos County — Trap operated July–September 1945, and April–October 1946. Total mosquitoes taken—270. *Aedes nigromaculis*—57, *A. thelcter*—2, *Anopheles pseudopunctipennis*—14, *Culex erraticus*—2, *C. quinquefasciatus*—28, *C. stigmatosoma*—2, *C. tarsalis*—110, *Culiseta inornata*—1, *Psorophora ciliata*—3, *P. confinnis*—17, *P. cyanescens*—4, *P. discolor*—1, and *P. signipennis*—26. Damaged specimens not specifically determined—3.

Potter County — Trap operated May–September 1945. Total mosquitoes taken—76. *Aedes dorsalis*—1, *A. nigromaculis*—25, *A. vexans*—3, *Anopheles pseudopunctipennis*—1, *Culex tarsalis*—15, *Psorophora cyanescens*—1, *P. discolor*—3, and *P. signipennis*—24. Damaged specimens not specifically determined—3.

Presidio County — Trap operated November 1945, and February–October 1946. Total mosquitoes taken—901. *Aedes dorsalis*—1, *A. thelcter*—12, *A. vexans*—389, *Anopheles pseudopunctipennis*—25, *Culex erraticus*—1, *C. quinquefasciatus*—38, *C. tarsalis*—250, *Culiseta inornata*—17, *Psorophora ciliata*—3, *P. confinnis*—63, *P. cyanescens*—2, and *P. signipennis*—94. Damaged specimens not specifically determined—6.

Reeves County — Trap operated April–October 1945 and April–September 1946. Total mosquitoes taken—3,462. *Aedes dorsalis*—576, *A. nigromaculis*—180, *A. vexans*—13, *A. thelcter*—1, *Anopheles crucians*—1, *A. pseudopunctipennis*—274, *Culex erraticus*—114, *C. quinquefasciatus*—131, *C. stigmatosoma*—17, *C. tarsalis* — 1,819, *Culiseta inornata* — 55, *Psorophora confinnis*—3, *P. ciliata*—1, *P. cyanescens*—4, *P. discolor*—2, *P. signipennis*—146, and *Uranotaenia syntheta*—19. Damaged specimens not specifically determined—106.

Runnels County — Trap operated June–November 1945, and February–August 1946. Total mosquitoes taken—1,228. *Aedes dorsalis*—1, *A. nigromaculis*—1, *A. vexans*—484, *Anopheles pseudopunctipennis*—18, *A. punctipennis*—18, *A. quadrimaculatus*—1, *Culex erraticus*—183, *C. quinquefasciatus*—33, *C. restuans*—2, *C. stigmatosoma*—5, *C. tarsalis*—279, *Culiseta inornata*—46, *Psorophora ciliata*—19, *P. confinnis*—1, *P. cyanescens*—40, *P. discolor*—7, *P. signipennis*—74, and *Uranotaenia syntheta*—1. Damaged specimens not specifically determined—15.

San Saba County — Trap operated March–November 1945. Total mosquitoes taken—387. *Aedes alleni*—2, *A. vexans*—6, *Anopheles pseudopunctipennis*—1, *A. punctipennis*—10, *Culex erraticus*—4, *C. restuans*—4, *C. salinarius*—5, *C. tarsalis*—163, *C. quinquefasciatus*—106, *Culiseta inornata*—37, *Psorophora confinnis*—6, *P. discolor*—3, *P. signipennis*—21, and *Uranotaenia syntheta*—16. Damaged specimens not specifically determined—3.

Shackelford County — Trap operated March–July 1945. Total mosquitoes taken—2,225. *Aedes dorsalis*—1, *A. nigromaculis*—58, *A. thelcter*—1, *A. vexans*—6, *Anopheles pseudopunctipennis*—5, *A. punctipennis*—15, *Culex quinquefasciatus*—30, *C. erraticus*—22, *C. restuans*—2, *C. salinarius*—2, *C. stigmatosoma*—1, *C. tarsalis*—162, *Culiseta incidens*—1, *C. inornata*—3, *Psorophora ciliata*—35, *P. confinnis*—18, *P. cyanescens*—23, *P. discolor*—71, and *P. signipennis*—1,398. Damaged specimens not specifically determined—371.

Star County — Trap operated April–August 1946. Total mosquitoes taken—213. *Aedes scapularis*—3, *Anopheles pseudopunctipennis*—1, *A. quadrimaculatus*—1, *Culex coronator*—1, *C. erraticus*—12, *C. quinquefasciatus*—30, *Psorophora ciliata*—1, *P. confinnis*—3, *P. cyanescens*—9, *P. signipennis*—135, and *Uranotaenia lowii*—1. Damaged specimens not specifically determined—16.

Sutton County — Trap operated June, July and October, November, 1945, and May–July 1946. Total mosquitoes taken—529. *Aedes thelcter*—6, *A. vexans*—1, *A. alleni*—1, *A. atropalpus*—1, *A. nigromaculis*—2, *A. triseriatus*—2, *Anopheles pseudopunctipennis*—3, *A. punctipennis*—17, *Culex erraticus*—13, *C. quinquefasciatus*—357, *C. salinarius*—1, *C. stigmatosoma*—4, *C. tarsalis*—63, *Culiseta inornata*—5, *Orthopodomyia signifera*—1, *Psorophora cyanescens*—8, *P. signipennis*—35, and *Uranotaenia lowii*—1. Damaged specimens not specifically determined—8.

Terry County — Trap operated June–November 1945, and April–June 1946. Total mosquitoes taken—301. *Aedes dorsalis*—200, *A. nigromaculis*—14, *Aedes vexans*—2, *Culex quinquefasciatus*—7. *C. tarsalis*—47, *Culiseta incidens*—2, *C. inornata*—1, *Psorophora confinnis*—1 and *P. signipennis*—19. Damaged specimens not specifically determined—8.

Tom Green County — Trap operated June–November 1945, and May–July 1946. Total mosquitoes taken—534. *Aedes vexans*—1, *A. nigromaculis*—1, *Anopheles pseudopunctipennis*—22, *A. punctipennis*—11, *Culex erraticus*—240, *C. quinquefasciatus*—32, *C. salinarius*—5, *C. stigmatosoma*—1, *C. tarsalis*—139, *Culiseta inornata*—2, *Psorophora ciliata*—3, *P. confinnis*—1, *P. cyanescens*—4, *P. discolor*—4, *P. signipennis*—45, and *Uranotaenia syntheta*—18. Damaged specimens not specifically determined—5.

Upton County — Trap operated July–September 1945, and January, August, and September, 1946. Total mosquitoes taken—1,521. *Aedes dorsalis*—17, *A. nigromaculis*—4, *A. vexans*—1, *Anopheles crucians*—3, *A. pseudopunctipennis*—1, *A. quadrimaculatus*—2, *Culex erraticus*—3, *C. quinquefasciatus*—27, *C. salinarius*—6, *C. tarsalis*—1,178, *Culiseta inornata*—16, *Mansonia perturbans*—5, *Psorophora confinnis*—12, *P. cyanescens*—12, *P. signipennis*—167, and *Uranotaenia sapphirina*—1. Damaged specimens not specifically determined—66.

Uvalde County—Trap operated June–November 1945, and February, April, and May, 1946. Total mosquitoes taken—565. *Aedes alleni*—2, *A. thelcter*—5, *A. vexans*—20, *Anopheles pseudopunctipennis*—6, *A. punctipennis*—10, *A. quadrimaculatus*—1, *Culex erraticus*—8, *C. quinquefasciatus*—363, *C. stigmatosoma*—2, *C. salinarius*—2, *C. tarsalis*—86, *Culiseta inornata*—8, *Psorophora ciliata*—7, *P. confinnis*—7, *P. cyanescens*—12, *P. discolor*—2, *P. signipennis*—4, and *Uranotaenia syntheta*—3. Damaged specimens not specifically determined—17.

Val Verde County — Trap operated June–November 1945, and January, February, April–June, 1946. Total mosquitoes taken—2,080. *Aedes alleni*—1, *A.*

vexans—6, *A. thelcter*—5, *Anopheles crucians*—2, *A. pseudopunctipennis*—223, *A. punctipennis*—222, *A. quadrimaculatus*—2, *Culex abominator*—1, *C. erraticus*—252, *C. nigripalpus*—1, *C. quinquefasciatus*—56, *C. restuans*—3, *C. tarsalis*—328, *Culiseta inornata*—136, *Psorophora ciliata*—3, *P. confinnis*—14, *P. cyanescens*—51, *P. discolor*—3, *P. signipennis*—744, and *Uranotaenia syntheta*—13. Damaged specimens not specifically determined—6.

Wheeler County—Trap operated May–November 1945, and April and June 1946. Total mosquitoes taken—532. *Aedes dorsalis*—6, *A. nigromaculis*—54, *A. vexans*—11, *Anopheles pseudopunctipennis*—4, *A. punctipennis*—1, *Culex erraticus*—3, *C. quinquefasciatus*—115, *C. restuans*—1, *C. salinarius*—2, *C. tarsalis*—198, *C. stigmatosoma*—1, *Culiseta inornata*—21, *Psorophora confinnis*—8, *P. cyanescens*—1, *and P. signipennis*—49. Damaged specimens not specifically determined—57.

Webb County—Trap operated April–October 1946. Total mosquitoes taken—353. *Aedes aegypti*—3, *A. vexans*—2, *A. thelcter*—25, *Anopheles pseudopunctipennis*—6, *Culex abominator*—2, *C. erraticus*—4, *C. quinquefasciatus*—197, *C. tarsalis*—15, *Psorophora ciliata*—2, *P. confinnis*—11, and *P. signipennis*—80. Damaged specimens not specifically determined—6.

Wichita County—Trap operated March–August, October, 1945, and June 1946. Total mosquitoes taken—3,069. *Aedes nigromaculis*—507, *A. taeniorhynchus*—3, *A. triseriatus*—4, *A. vexans*—415, *Anopheles crucians*—2, *A. pseudopunctipennis*—4, *A. punctipennis*—4, *A. quadrimaculatus*—3, *Culex abominator*—3, *C. erraticus*—91, *C. quinquefasciatus*—55, *C. restuans*—31, *C. salinarius*—41, *C. tarsalis*—259, *Culiseta inornata*—41, *Toxorhynchites rutilis septentrionalis*—1, *Orthopodomyia signifera*—6, *Psorophora ciliata*—63, *P. confinnis*—649, *P. cyanescens*—53, *P. discolor*—6, *P. signipennis*—364, *Uranotaenia lowii*—1, and *U. syntheta*—5. Damaged specimens not specifically determined—458.

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McGregor, T., and Eads, R. B. 1943. Mosquitoes of Texas. *Jour. Econ. Ent.* 36(5): 938.

O'Neill, K., Ogden, L. J., and Eyles, D. E. 1944. Additional Species of Mosquitoes found in Texas. *Jour. Econ. Ent.* 37(4): 555.

NEWS AND NOTES

DUKE UNIVERSITY SUMMER SESSION announces a course in Acarology. Zoology S231. Acarology—An introductory study of the Acarina or mites and ticks with special emphasis on those of economic and medical importance. Lectures, recitations and laboratory daily, 8:00–12:00, 2:00–4:00. August 20–September 7, 1951. Associate Professor G. W. Wharton.

During recent years research on the Acarina at Duke University and elsewhere has greatly expanded as a more complete recognition of the economic and medical importance of the mites has been realized. With the advance in knowledge there has been an increasing number of requests for information concerning this group.

The course, designed for students, professional entomologists, and zoologists, will present a survey of the knowledge of the Acarina that embraces structure, systematics, biology, literature, and techniques. The course will be limited to twenty students and will not be offered for fewer than ten students.

Fees and expenses for the three weeks (August 20–September 7) the course is in session will be: University fee, $36.00; Dormitory, $10.50–$20.00; Meals, $35.00 (estimate based on prices in University cafeterias).

For additional information, application blanks, and a copy of the Bulletin of the Summer Session write to The Director of the Summer Session, Duke University, Durham, North Carolina.

CANNIBAL MOSQUITOES IN HAWAII

Mr. C. E. Pemiberton, entomologist of the Hawaiian Sugar Planters Association has arranged with D. J. Muspratt, entomologist of the South African Institute for Medical Research in Johannesburg, to ship specimens of the cannibal mosquito *Megarhinus brevipalpis* to the Hawaiian Health Department. Three shipments were received by November 1950, one containing full grown larvae shipped on moist blotting paper. Adults have been reared, these laid viable eggs, and laboratory breeding is proceeding. We wish Drs. Bonnet and Hu, who are handling this project better luck in establishing this line of attack on their pest mosquitoes than was experienced by Mr. Pemiberton in a previous attempt. In that instance *M. inornatus,* introduced from New Britain in 1929 was temporarily established but died out in a few months.

F. C. Bishopp

EXCERPT from letter from Fernando M. de Bustamante to H. L. T., in response to her request for reviews and abstracts from Brazil:

"I would like very much to be an assistant of the Reviews and Abstracts Department of MOSQUITO NEWS in Brazil. . . . There are two official Services working on malaria control in Brazil: The National Malaria Service of the National Department of Health and the Malaria Service of the Public Health Department of the State of São Paulo. The Special Service of Public Health (SESP), which worked on malaria in the Amazon Valley up to 1949, transferred to the National Malaria Service the responsibility of making malaria control in that large area. Dr. Leonidas Deane, who was in charge of the Malaria Division of the Special Service of Public Health is now engaged in the National Malaria Service. There is also a private malaria control Service in the water reservoir of Rio de Janeiro and São Paulo Cities Light and Power Company Limited. Dr. Abel Vargas is in charge of this private service.

"Most of the papers dealing with malaria, anophelines and malaria control in Brazil are published now in 'Revista Brasileira de Malariologia (Brazilian Journal of Malariology), that is printed by the National Malaria Service. This journal makes English summaries of all the papers. . . ." Sincerely yours, Fernando M. de Bustamante.

From a letter from R. F. Peters, Nov. 14, 1950:

"Enclosed is a photograph prepared by Tommy Mulhern of one light trap collection in a mosquito control area in California, which trap operated continuously for three days and nights. See the October 15 issue of *Mosquito Buzz.* Seated before the 345,000 plus or minus mosquitoes is Bettina Rosay, Junior Entomologist of our California Central Valley Mosquito Ecology study."

Bill Perry has sent in an interesting letter from London, where he is Assistant Scientific Liaison Officer for the Medical Sciences between the United States, Great Britain and Western Europe. He writes:

"Have just returned from a month's trip through Italy, Switzerland and France visiting the various medical schools, research laboratories and hospitals. Didn't have much of an opportunity to do extensive, specific investigations in entomology although I did enjoy making a number of personal contacts in Italy and Amsterdam.

"I was particularly interested in the work of Pavan in Italy on his isolation of an active compound that he has demonstrated to be actively bactericidal and insecticidal. I have been doubly interested because I had picked up a similar thing in some of my later studies at Lejeune, just before getting orders over here to this new post.

"I have picked out three items from my official reports and had them mimeographed. I thought maybe you would be interested in publishing these at intervals in reviews and abstracts or as you see fit in Mosquito News. In any case they will probably be of interest to you. I shall keep you posted on my entomologic findings in this area.

"Am leaving for Spain and Portugal on the 15th of March."

Editor's Note: The "items of interest" are as follows:

Miscellaneous Notes on Entomological Studies in Italy: Iridomyrmecin, a New Bactericidal and Insecticidal Agent. For the past four years, Dr. Mario Pavan, working in collaboration with Dr. Attilia Nascimbene at the Instituto di Anatomia Comparata dell' Universita di Pavia, Italy, has been attempting to isolate antibiotic substances from many species of insects and arachnids.

These investigators have reported (La Ricerca Scientifica 20, 1853 (1950)), the isolation of a highly active cystalline compound, which they call "iridomyrmecin," from extracts of the Argentine ant, *Iridomyrmex pruinosus humilis*. The active principle obtained from these ants does not owe its activity to formic acid, which according to Pavan is not formed by members of this group.

Specific details on the tedious and lengthy isolation of iridomyrmecin are not yet available. At present, the time required for production of the crystalline product is about four months after the initial extraction. The most active materials have been obtained from an ether insoluble residue. Dr. Pavan believes that within six months chemical, physiologic, and toxicologic studies will be complete.

Tests in vitro have shown *iridomyrmecin* to be effective against *Vibrio comma, Staphylococcus aureus, Bacillus anthracis, Brucella melitensis, Br. abortus, Br. suis, Escherichia coli, Proteus vulgaris, Salmonella paratyphi* B, *Eberthella typhosa, Mycobacterium phlei, Mycobacterium avium, Shigella paradysenteriae* and *Micrococcus lisodeikticus*.

Of special interest in the report of Pavan is that this bactericidal substance has been demonstrated to possess insecticidal powers, and laboratory tests have shown it to be effective against DDT resistant houseflies (see the following item).

Studies on DDT Resistant Insects in Italy. With the introduction of DDT in 1944 for the control of insect vectors of malaria and typhus in Italy, there has been a gradual increase in the number of species exhibiting resistance to the action of this insecticide. In particular, the house fly, *Musca domestica,* has become markedly resistant to DDT and there are indications that within a year, flies resistant to Octa-Klor will also appear. This resistance of "filth" flies to these two important commercial insecticides has resulted in a significant rise in the incidence of fly-borne bacillary dysentery in the rural areas with prominent and alarming peaks occurring in the summer months.

In view of these trends, work is being conducted by Professor A. Missiroli, chief of the Instituto Superiore di Sanita at Rome to separate pure lines within the species *Musca domestica,* to study the heredity of character resistance to insecticides by crossing resistant with non-resistant strains of *Musca domestica,* and to study the taxonomic relations existing between *Musca domestica, vicina* and *nebulo*.

The laboratory in Romé, and a field station located in the Province of Latina, Italy, are well equipped to conduct experimental studies on new insecticides and on the physiology and biology of *Musca domestica* and its resistant strains. Professor Missiroli has given the name *Musca domestica* var. *tiberina* to the variety of housefly which has within the last two years occupied all regions treated with DDT.

At the Instituto di Anatomia Comparata dell' Universita di Pavia, Dr. Mario Pavan has demonstrated his newly named "iridomyrmecin" to be effective against DDT resistant houseflies.

Fortunately, the control of anophelines in the highly malarious areas of the Pontine Marshes near Rome had been accomplished before a noticeable resistance appeared in the genus *Anopheles*. Autochthonous malaria, therefore, has practically disappeared from Italy and during 1950 only about 350 cases were reported. The most highly endemic areas were Sicily and Sardinia.

Identification of Anopheles by Salivary Gland Chromosome Patterns. Early in 1947, Dr. Guido Frizzi of the Istituti di Zoologia e Genetica, Università di Pavia, Italy, reported (Nature, 160, 226 (1947)) considerable success in "mapping" salivary gland chromosome patterns in fourth instar anopheline larvae. Since that time he has continued his investigations to evaluate the degree of variation within natural mosquito populations and to determine whether comparative karyology might not provide an

additional tool in the study and identification of geographic, ecologic, and physiologic variants within the genus *Anopheles*. Such a method of identification will be important in the difficult separation of malaria vectors in the *maculipennis* complex of anophelines in Europe. Dr. Frizzi has completed studies on *Anopheles maculipennis* var. *atroparvus* and has made direct comparisons of the salivary gland patterns of *elutus, typicus* and *messeoe*. It appears that his techniques, once the general patterns are recognized and identified, can be used to facilitate identification of this group of mosquitoes.

In hybrids obtained from crosses with female *typicus* and male *atroparvus,* the salivary gland chromosomes show a heterozygous inversian in the III chromosome's "right" arm. The three chromosome pairs are incompletely paired and unpaired segments are more numerous and more extended. It would appear that the total or partial sterility of hybrids within the *maculipennis* species is correlated with chromosomal rearrangements.

Studies are planned to "map" and compare the patterns of representatives of the *maculipennis* stock known to occur in the United States.

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EDITORIAL

At the annual meeting of the American Mosquito Control Association, which was held jointly with that of the Illinois Mosquito Control Association in Chicago on March 5, 6, 7, and 8, 1951, the publication of the Proceedings was the subject of considerable thought and discussion. It was decided that the scientific papers presented at the meeting will be published in *Mosquito News,* distributed among the four issues of the year. The funds contributed by the host Association (the Illinois Mosquito Control Association) will be utilized to make it possible to print additional pages in each issue to accommodate the increased number of papers.

Thus the Proceedings papers will be assured of the same circulation as *Mosquito News.* At the same time, the *News* will not have to delay current contributions in order to include papers from the Proceedings.

It is anticipated that some of the Proceedings papers will have to be shortened in order to conform to the practice of not exceeding six printed pages. The editors will in some cases suggest how a paper may be condensed; in other instances a paper may be returned to the author with a request that he shorten it as he sees fit. The cooperation of all contributors is solicited.

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OBITUARY

COLONEL CHARLES FRANKLIN CRAIG 1872–1950

Colonel Charles Franklin Craig, an outstanding figure in tropical medicine, died in San Antonio, Texas, on December 9, 1950, at the age of 78.

For many years Colonel Craig served in the Medical Corps of the Army, from which he retired in 1931. He was recognized as an international authority in the fields of bacteriology and preventive medicine and made notable contributions to medical entomology. Colonel Craig held many responsible positions in the Medical Corps, including Director of the Department of Preventive Medicine and Clinical Pathology of the Army Medical School and Assistant Commandant, Army Medical Center, Washington, D. C. He was stationed for a number of years in the Philippines where he carried on research on malaria, dengue, and filariasis. In 1906 he and Major Ashburn confirmed the work of Graham which showed that dengue was transmitted by *Culex fatigans (=quinquefasciatus)*. Subsequently Craig and Ashburn traced the development of a human filarid in this same species of mosquito. These workers were probably the first (1907) to observe the concentration of microfilariæ of the non-periodic type of *Wuchereria bancrofti* at the point where the mosquito injects its saliva.

After Colonel Craig's retirement from the Medical Corps he served as Director of the Graduate School of Medicine and later as Professor Emeritus of Tropical Medicine in Tulane University. He was the author of many publications in the field of preventive medicine, a considerable number of which dealt with the insect transmission of disease. The book "Clinical Parasitology" by Craig and Faust is a widely used text in that field. In his article "Importance to the Army of diseases transmitted by mosquitoes and methods for their prevention" (1910) this entire subject is admirably summarized.

Colonel Craig was the recipient of the Founders' Medal for notable contributions to military medicine and the Franklin Medal for his publications on tropical medicine. He was active in the Academy of Tropical Medicine of which he was president (1935), in the American Society of Tropical Medicine (president 1913) and the American Society of Parasitologists (president 1935). He served as editor of the American Journal of Tropical Medicine for 20 years.

In Danbury, Connecticut, Colonel Craig was born on the fourth of July, 1872. He received his M.D. degree from Yale in 1894 and honorary M.A. in 1914. He is survived by his widow, Mrs. Lilian Osmoun Craig, a daughter, Mrs. Marjorie Goolrick, and a son, Major General Edward A. Craig, U. S. Marine Corps.

—F. C. Bishopp

ASSOCIATION NEWS

AMERICAN MOSQUITO CONTROL ASSOCIATION, INC., 1951

The incoming officers and directors of AMCA send greetings to the members and friends of the Association. The recent Annual Meeting in Chicago, held jointly with the Illinois Mosquito Control Association, was an outstanding success. Members of AMCA were present from all parts of the United States, and from Canada, Hawaii, and Panama. The accommodations and hospitality provided by our gracious Illinois hosts were excellent and will not soon be forgotten.

At the Chicago meetings the new bylaws for the Association, which have been in preparation for several years, were unanimously adopted. Officers and regional directors were elected, standing committees were appointed, and the need for certain special committees was considered. The personnel of these special committees will be announced later, after consultation with the chairman and proposed members of such committees.

The 1952 Annual Meeting will be held jointly with the Utah Mosquito Abatement Association, in Salt Lake City, March 24–27, 1952. Keep those dates free on your calendar, and salt a little away for the '52 meeting in Salt Lake City!

The new Board of Directors congratulates the previous officers in particular, and all members of the Association in general, for bringing the Association safely and soundly through the difficult interim period of incorporation and reorganization which has just been completed; for the existing stability now established in this organization; and for the harmonious relationships that have been developed under their able leadership. The Association is now truly national in scope, or rather international, and is now in a position substantially to increase the membership, and the usefulness of AMCA in the interest of better and more effective mosquito control. Your present officers and members of committees pledge their services to this end, and request the united cooperation and assistance of all members to attain the objectives of the AMCA.

For greater membership, we urge each member to contact all friends and acquaintances engaged in mosquito work and persuade them to join the Association. Some mosquito control agencies have enrolled all their Board Members or Commissioners, as well as their technical and supervisory personnel as members of AMCA. Others have not realized the value to their own local programs of utilizing this means of aiding the Board personnel better to discharge the responsibilities they assumed upon accepting appointment to a mosquito control agency. To have Mosquito News coming regularly to the home of administrative officers provides a steadily increasing fund of information readily available for use when they have leisure time for reading. It also stimulates them in their work through the friendly contact provided by the News, with other mosquito workers in remote places. Board Members and Commissioners make a personal sacrifice every time they desert their private business to give time and effort to mosquito control. The meetings of the mosquito control boards are usually so full of the immediate business of the organization that there is little if any time for anyone to present an account of what is being done elsewhere. A membership in AMCA and a subscription to Mosquito News is surely but a small reward for a district or commission to provide each of its board members for their service to the community! It is at the same time a sound business practice providing a valuable tool which may be used in determining the course to follow to give better service in their local control programs.

This is your Association. Your representatives on the Board of Directors and committees are trying to make it mean to you what you want it to mean. Your comments and ideas are requested and every officer and committee member will welcome all help and assistance you can contribute.

Make 1951 a banner year for AMCA!

New Officers and Committees

Board of Directors and Officers: Listed on the back cover of Mosquito News.

Committee on Publication of Mosquito News: Listed on inside front cover together with names of the editorial and business staffs of Mosquito News.

Standing Committee on Finance: R. E. Dorer (Treasurer), chairman, 300 Essex Bldg., Norfolk, Va.; Donald MacCreary, Univ. of Delaware, Newark, Del.; D. Manley Jobbins, N. J. Agr. Expt. Station, New Brunswick, N. J.; Fred H. Stutz, 1909 Dade Co. Court House, Miami, Fla.; T. G. Raley, Box 278, Selma, Calif.; Harold F. Gray, 1A Court House, Oakland, Calif.; H. W. Van Hovenberg, Box 288, Mount Pleasant, Texas; Dr. F. C. Bishopp, Bur. Entom. & Plant Quar., USDA, Washington 25, D. C.; H. H. Stage, Bur. Entom. & Plant Quar., USDA, Washington 25, D. C.; Frank A. Steinrock, Todd Shipyards Corp., 8116–45th Ave., Elmhurst, Queens, N. Y.; Financial Adviser to the Committee: M. M. Stallman, 15 Summitt St., East Orange, N. J.

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Standing Committee on Miscellaneous Publications: Robert L. Vannote, Chairman, 3 Franklin Place, Morris Plains, N. J.; William E. Bickley, Univ. of Maryland, College Park, Md.; H. D.

Joint meeting of American Mosquito Control Association and Illinois Mosquito Control Association, Drake Hotel, Chicago, Illinois, March 5, 6, 7-8, 1951.

Peters, City Health Dept., 940 Main St., Jacksonville, Fla.; Robert L. Armstrong, E. Middlesex Mosq. Con. Project, City Hall, Cambridge, Mass.; J. L. Clarke, 8130 Ogden Ave., Lyons, Ill.; T. G. Raley, Box 278, Selma, Calif.; Lester W. Smith, Parsonage Road, Metuchen, N. J.; H. H. Stage, Bur. Ent. & Plant Quar., USDA, Washington 25, D. C.; R. E. Dorer, 300 Essex Bldg., Norfolk, Va.

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Program Committee for 1952 Meetings: Dr. C. R. Twinn, Chairman, Dept. of Agric., Ottawa, Ontario, Canada. The 10 Regional Directors comprise remainder of committee.

Arrangements Committee for 1952 Annual Meeting: Mr. T. A. Schoenfeld, Salt Lake City Mosq. Ab. Dist., 401 City & County Bldg., Salt Lake City, Utah. (Naming of balance of committee deferred.)

Special Committee on Research and Developments: Dr. B. B. Pepper, Chairman, N. J. Agr. Expt. Station, New Brunswick, N. J. (Naming of balance of committee deferred.)

HONORARY MEMBERS

Previously elected: Dr. J. A. LePrince, Memphis, Tenn.; Dr. Charles C. Adams, Albany, N. Y.; Dr. Robert Glasgow, Albany, N. Y.

Elected at 1951 Annual Meeting: Dr. Robert Matheson, Ithaca, N. Y.; Dr. Lewis W. Hackett, Berkeley, Calif.

REVIEWS AND ABSTRACTS

FIELD EXPERIMENTS WITH DDT EMULSION AND WETTABLE DDT WITH SPECIAL REFERENCE TO MALARIA INCIDENCE IN SWAZILAND DURING THE TRANSMISSION SEASON 1949/50. By O. Mastbaum. United Nations, World Health Organization, African Malaria Conference 7, Oct. 9, 1950. An experiment was set up whereby nearly 23,000 native huts, housing approximately 35,000 persons, were sprayed with one application of DDT, either a three and one-half per cent emulsion or a five per cent wettable powder. Using hand sprayers, a total of 9,900 gallons of spray was applied to the interior of the huts.

Weekly checks for *Anopheles gambiae* hut infestation were made from February to June. About five per cent of the total dwellings sprayed were sampled.

During the non-transmission season a survey was made on 500 children under 12 to determine the static load of parasites carried over. During the transmission season over 3000 blood smears were examined to determine degree and type of parasitic infection.

The same sampling procedure was followed in untreated control areas.

A considerable reduction in numbers of *gambiae* (not exceeding 0.04 per month) was obtained in sprayed areas for at least three months. No control differences were noted between the two types of DDT.

In epidemic and endemic areas there was no rise in malaria incidence over that recorded for the non-transmission season; however, in view of the low *gambiae* infestation, transmission was remarkably high in hyperendemic areas. Though difficult to explain, certain influencing factors are discussed.—R. F. Darsie, University of Delaware, Newark, Delaware.

THE SPECIES AND SUBSPECIES OF VECTORS AND THEIR BIONOMICS. By Botha De Meillon. United Nations, World Health Organization, African Malaria Conference 10, Oct. 10, 1950. The report is based on the author's recent book "Anophelini of the Ethiopian Geographical Region" (reviewed in MOSQUITO NEWS 8(4):198, 1948) and subsequent information supplied by collaborators. A list of twenty species and subspecies of *Anopheles*, found infected in nature with malaria parasites, is given. The geographical distribution, known information on adult and larval bionomics, abundance, and relative importance as a vector are included.

The two major malaria carriers, *gambiae* and *funestus*, are treated quite thoroughly. The author points out that *gambiae*, by far the most important vector of epidemic malaria in Africa, is markedly influenced by climatic conditions, and therefore, behaves differently in the various parts of its range.

Under certain conditions two of the secondary vectors, *moucheti moucheti* and *gambiae melas*, are principal malaria transmitters.—R. F. D.

NOTE ON MALARIA EPIDEMIOLOGY IN FRENCH WEST AFRICA. By M. M. Holstein. United Nations, World Health Organization, African Malaria Conference No. 6, Oct. 3, 1950. The author lists the *Anopheles* mosquitoes identified between Aug. 1, 1948, and Mar. 31, 1950, in nine territories of French West Africa. Results of 8000 mosquito dissections reveal that *gambiae*, *funestus*, and *rufipes* show the highest rate of infection with sporozoites and oocysts. These three species are rated as primary vectors of malaria, while *nili* and *pharoensis* are secondary vectors, and *hancocki* and *domicolus* subsidiary vectors. In a discussion of the primary vectors, the author points out that in certain localities *rufipes* is the main carrier. He maintains that *funestus* and *gambiae* are of equal importance in transmission of malaria, when the year-round picture is considered.

A survey of one district (Bobo-Dioulasso) disclosed that *Plasmodium falciparum* was involved in over 90 per cent of the malaria cases.—R. F. D.

ANOPHELES AND MALARIA IN THE NEAR EAST. By H. S. Leeson, W. H. R. Lumsden, J. Yofe, and T. T. Mecan. London School of Hygiene and Tropical Medicine, Memoir 7, pp. xii and 223, figure 73, 1950. H. K. Lewis & Co. 35 shillings. This is the first memoir of this series published since 1932 and it consists of three separate papers on different areas of the Near East. The first of these (by Major Leeson) covers Syria and Lebanon, the second (by Drs. Lumsden and Yofe) Transjordan, Palestine and Syria, and the third (by Dr. Macan) Iraq and northern Persia. As Professor Buxton states in the introduction, these areas are of particular interest to the entomologist and malariologist since much of the area is semi-arid and because it lies between the great faunal areas of the Palaearctic, Ethiopian, and Oriental Regions—the majority of the *Anopheles* species coming from the first of these. The papers are the results of military epidemiological work done in these areas by Malaria Field Laboratories of the Royal Army Medical Corps and are primarily of the survey type, giving very valuable information on geography, meteorology, and mosquito and malaria incidence. The principal vectors are: *Anopheles sacharovi, A. claviger, A. superpictus, A. sergenti, A. stephensi,* and *A. maculipennis,* the latter being important only on the Persian plateau, *sergenti* only in Transjordan, Palestine and Syria, and *stephensi* only on the alluvial plain of Iraq. A few taxonomic notes are given but there are no keys or descriptions of the species. The illustrations consist primarily of maps, splendid photo-

graphs showing environments, and charts of malaria and mosquito incidence. This is a very fine work to reactivate this Memoir series, and will be of utmost value to anyone interested in reducing the toll of malaria in the Near East.—Alan Stone, Bureau of Entomology and Plant Quarantine, Washington, D. C.

The Occurrence of *Anopheles crucians* in Guatemala. J. M. Brennan. Am. Jour. Trop. Med. 31(1):138, 1951. A new distributional record is given for *Anopheles crucians crucians* Wiedemann. Heretofore, according to Kumm, it was confined in Central America to the Atlantic slope of British Honduras, Honduras, and Nicaragua. The present report extends the distribution to the Pacific slope; and, for the first time, records its presence in Guatemala. There is reason to believe that the species may be, and very possibly has been for some time, well established in this area.—D. V. Jensen, National Institutes of Health, Bethesda, Md.

A Study of the Concentration of Yellow Fever Virus Which Will Infect Certain Species of *Aedes* Mosquitoes. By H. W. Kumm, and H. W. Laemmert, Jr., Am. Jour. Trop. Med. 30(5):749–755. 1950.

1. A study was made of the concentration of virus which was necessary to infect certain species of *Aedes* mosquitoes with yellow fever.

2. The lowest titer at which transmission by bite occurred was $10^{-3.0}$.

3. Half or more than half of the mosquitoes, which fed on primates circulating yellow fever virus at titers of $10^{-5.0}$ or above, became infected after extrinsic incubation periods of at least 28 days at 28° C.—Authors' summary.

The Propagation of Japanese Encephalitis Virus in the Mosquito by Parenteral Introduction and Serial Passage. By H. S. Hurlbut. Naval Medical Research Institute, National Naval Medical Center, Bethesda, Md. Project NM 005, 048. 03.11 (Formerly NM 005 007). Aug. 1950.

1. Propagation of the virus of Japanese encephalitis in *Culex quinquefasciatus* was demonstrated by parenteral injection and serial passage.

2. The emulsified whole bodies of the mosquitoes gave LD_{50} titers of 6.5–8.4 when injected intracerebrally into mice.

3. Virus could be demonstrated in appreciable amount 24 hours after injection into the mosquito and was present in relatively high concentration after 48 hours. Close to the maximum titer appeared to be reached on the third or fourth day and presumably there was no great change thereafter for as long as 17 days.

4. Mosquitoes which were injected parenterally with the virus transmitted it to suckling mice by bite after as little as 48 hours of incubation at 30° C.—Author's summary.

Ed. Note: The mosquitoes were anesthetized with carbon dioxide; a steel needle about 0.1 mm. in diameter was wet with the virus suspension and inserted through the body well into the thorax.

Mosquito Fauna of Japan and Korea. Pp. 1–268 and appendices pp. 1–7 and 1–213. 95 plates, 95 figs. Walter J. La Casse and Satyu Yamaguti. Office of the Surgeon HQ 8th Army, APO 343, 1950.

In Mosquito News 8(4):200, 1948, I reviewed a work by the same authors under the same title. We now have a greatly revised and much improved edition. The first portion is taxonomic and 51 species or subspecies of mosquitoes are treated, 13 more than in the previous edition. One new species, *Culiseta nipponica,* is described from the larva. Keys are given for the species wherever necessary and each species is described as fully as possible, with excellent plates showing adult, larval and pupal characters. The biology of each is discussed at considerable length, wherever this is known, and a map is given showing Japanese distribution. The first appendix of 7 pages describes the female genitalia for 17 genera or subgenera. The second appendix contains 11 sections dealing with biology, control, technique, disease transmission, and Korean distribution, with many figures, tables, and graphs. The final illustration shows the staff of seven artists preparing the plates under Dr. Yamaguti's direction. It is an excellent work and should be in the hands of everyone seriously interested in the mosquitoes of Palaearctic Asia. Specialists may obtain a copy from Lt. Col. F. W. Whittemore, Div. of Prev. Med., Office of the Army Surgeon General, Washington 25, D. C.—Alan Stone, U. S. Dept. of Agriculture, Washington, D. C.

Studies on *Aedes vexans* (Meig.) and *Aedes sticticus* (Meig.), Flood-Water Mosquitoes, in the Lower Columbia River Valley. C. M. Gjullin, W. W. Yates and H. H. Stage. Ann. Ent. Soc. Am. 43(2):262–275. 1950. The flooded lowlands of the Columbia River Valley present ideal breeding places for the floodwater mosquitoes, *Aedes vexans* and *A. sticticus.* Over a period of 18 years numerous studies were conducted and many conclusions were reached.

Eggs, laid by caged females after a blood meal, developed completely in 9 per cent of those 4 to 6 days old; in 75 per cent of those 8 to 10 days old. It was found in 1939 that the eggs would not hatch in tap water or in water taken directly from the Columbia River, but that they would hatch in water containing small amounts of certain amino acids and potassium phosphate. In later studies it was discovered that the eggs hatched because of the reduction of dissolved oxygen. This reduction serves as a regulating mechanism insuring that the eggs will hatch only in the favorable environment of shallow water having an abundance of food material for the larvae.

It was determined that winter dormancy of eggs is caused entirely by low temperatures, since

hatches of dormant eggs have been obtained from heating soil samples before flooding. The time required for the *Aedes vexans* and *A. sticticus* eggs to hatch after they have been flooded varies with the degree of dormancy and with the temperature of the water at the time of flooding. Only a small percentage of these species' eggs hatch when water stands over the eggs continuously from late winter through the spring and summer months.

Studies of the distribution of these eggs in the Columbia River Valley have been made by taking 2 quart soil samples from many areas. The bulk of the eggs of these species are laid on ground flooded between the 10- and 20-foot levels of the river. Eggs were more prevalent in swales, pot holes and gullies than on level ground and ridges. Ground of a loam texture with a covering of vegetation and humus is preferred to bare areas exposed to the sun and wind.

The natural survival time of *Aedes vexans* and *A. sticticus* eggs was determined by biennially flooding cages containing top soil samples. It was observed that eggs of both species will survive in large numbers for two or three years and that small numbers of eggs may even survive for four years.

The viability of eggs is greatly reduced by a low moisture content in the soil. Placing egg-free soil over soil samples containing eggs resulted in a diminished per cent of hatching. Several species of Coleoptera were reported to be predaceous on *Aedes* eggs.

The time required for development of the aquatic stages is decreased with high temperatures and abundance of food. Larvae prefer shallow water of a neutral pH. Predators of *Aedes* larvae and pupae include the chironomid larvae of the genus *Palpomyia,* and the flatworm, *Palmaria maculata.* Experiments with *Gambusia patruelis* were unsuccessful due to predaceous fish.

A study was made of thousands of adult mosquitoes to determine the seasonal variations of sex ratios. Males predominated for 20 days after emergence due to the rapid dispersion of females. Then the greater longevity of the females caused the males to become less numerous.

The range of flight as determined by tests was 3 miles for *Aedes vexans* and 5 miles for *A. sticticus. A. vexans* predominated at ground level, while *A. sticticus* was numerous at 20–30 feet.

It was found that *sticticus* bites considerably less at night than in the daytime; little change between day and night was noted in the biting rate of *vexans.*

The relation between clothing colors and biting rate of *A. sticticus* suggest that colors are chosen on the basis of their spectral reflectances.

Naturally-mated females of both species readily lay eggs in laboratory cages if given blood meals. Under cage-mating conditions *Aedes sticticus* laid more than *A. vexans.* Although blood meals were readily taken by virgin females of *Aedes sticticus* and *A. vexans, sticticus* laid no eggs while embryos failed to develop in eggs laid by *vexans.*—H. A. Crandell, Toledo Area Sanitary District, Toledo, Ohio.

Anopheles (Anopheles) guarao SP. NOV. By Pablo J. Anduze and Antonio Capdevielle. Bol. de Ent. Ven. 8(3 & 4):119–124, 1949. The larva, pupa, adult, and male terminalia are described and the pupa figured for *A. guarao.* In an earlier paper by the authors the species was confused with *Anopheles (Shannoniella) mediopunctatus* Lutz (en Theobald) and the species is herein clarified. The terminalia of *A. guarao* resembles that of *A. punctimacula* but the adult is similar in coloration to *A. mediopunctatus,* which is of a different subspecies. In the larval stage there are many variations in the preclypeal external hairs and thus the larva may be easily confused with *A. neomaculipalpus.*—Ernestine B. Thurman, Bureau of Vector Control, Berkeley 4, California.

BIOMETRICAL STUDIES ON INTERGRADATION IN THE GENITALIA OF CERTAIN POPULATIONS OF *Culex pipiens* AND *Culex quinquefasciatus* IN THE UNITED STATES. By S. Sundararaman. Amer. Jour. Hyg. 50(3):307–314, 1949. Evidence is presented after the study of lengthy series of specimens to substantiate early theories and the recent work of Farid (1949) determining *Culex pipiens* Linnaeus, 1758 and *Culex quinquefasciatus* Say, 1823 to be subspecies. The range of variation in the dorsal and ventral arms of the phallosome of wild-caught males of the northern *C. pipiens* was compared with that of the southern *C. quinquefasciatus* and with laboratory-reared hybrids. The author's summary is:

1. Measurements made of the genitalia of *Culex pipiens* from Baltimore, Md., *Culex quinquefasciatus* from Texas and Georgia, laboratory hybrids and *Culex quinquefasciatus* from Alabama, favor the adoption of the ratio of the distance between the tips of the dorsal arms and the distance between the tips of the dorsal and ventral arms as a means of identification of these populations.

2. Experimental hybrids obtained from two successive generations of homologous crosses between *Culex pipiens* from Baltimore and *Culex quinquefasciatus* from Texas exhibited intermediate genitalic characteristics.

3. A few specimens caught in what may be the mid-zone of the range of *Culex pipiens* and *Culex quinquefasciatus* also had intermediate genitalia similar to those of the experimental hybrids. The Alabama *"C. quinquefasciatus"* colony may have been established from naturally occurring hybrid specimens.

4. Since hybridization between the northern and southern types appears to occur in nature as well as in the laboratory it is believed that the northern *Culex pipiens* and southern *Culex quinquefasciatus* are subspecies.—E. B. T.

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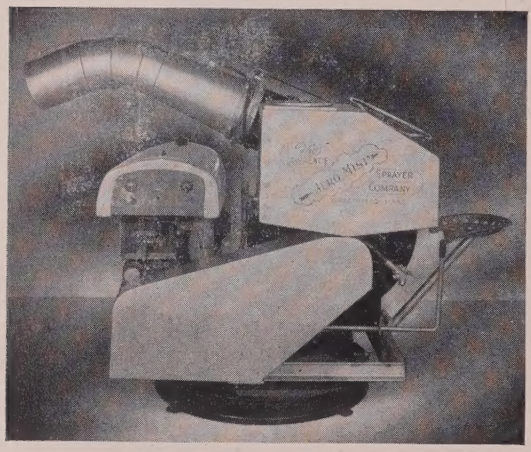

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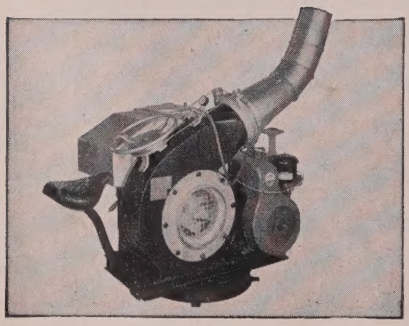

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